



### **450 KW PALM WASTE COGENERATION POWER PLANT**

NSV Energy LLC pleased to offer palm waste cogeneration power plant, complete from equipment supply, installation, commissioning and guarantee.

Boiler is two pass chain grate furnace type 10 tons/hr , 25 Bar design and operating at 22 bar saturated steam pressure. Fuel consists of 70% Palm fibre and 30% kernel shell, 2850 kgs/hr , boiler efficiency 70% based on HHV 4207 kcal/kg. Dust collector and ESP provide emission < 50 mg/Nm<sup>3</sup>.

Skid mounted steam turbine generator set , 450 kw with single stage , 4700 rpm steam turbine , inlets team 22 bar and exhaust steam 3.5 bar, gear reducer 4700 rpm to 1800 rpm and 565 kva, 480 v , 0.8 pf, air cooled generator .

When plant running Auxiliary power consumption 190 kw and net power for plant use 260 KW and 10TPH steam 3.5 bar.

Project cost \$1,300,000

**PALM WASTE BOILER 10 TPH 25 BAR SATURATED**



Fuel: Palm waste (Mixture Palm fibre 70% and palm Kernel Shell 30% ) 2850 kgs/hr

Boiler efficiency based on GCV: 70%

Design: ASME/ASTM standards

**Palm Waste Fired Biomass Boiler – Capacity: 10t/hr**

**Operating Pressure: 22 barg**

**Steam temperature: Saturated**

**A) TECHNICAL SPECIFICATION FOR BOILER**

1. Steam Boiler

To fabricate one (1) unit steam boiler consists of below and generally in accordance to specification enclosed.

Each Boiler Consist Of :-

- 1.1 Boiler Main Body, Drum, Furnace and Tubes - 1 set
- 1.2 Economizer
- 1.3 Air Preheater
- 1.4 Steel Frame – 1 lot
- 1.5 Platform & Ladder – 1 lot
- 1.6 Refractory – 1 lot
- 1.7 Insulation – 1 lot

2. Auxiliary Equipment

Each Boiler Consist Of :

- 2.1 FD Fan – 1 unit
- 2.2 ID Fan – 1 unit
- 2.3 Instrument & Valve Control System – 1 set
- 2.4 Feed Water Pump – 2 unit
- 2.5 Dust Removal – 1 unit
- 2.6 Electrostatic Precipitator – 1 set

## **BOILER SPECIFICATION**

### **Evaporation Rate :**

10t/hr \_\_\_\_\_ From & At 100 Deg. C.

### **Max. Allowable Working Pressure :**

25 barg (normal working pressure: 22 barg)

### **Working Temperature :**

Saturated

### **Type :**

Three pass, water tube, integral furnace, water tube boiler with chain grate furnace.

### **Construction Code :**

Construction of the boiler is in strict accordance with ASME Section I.

### **Steam and Water Drum :**

The steam and water drum of the boiler shall be manufactured from steel plate material of ASME/ASTM Standard. The drum shall be equipped with one standard manhole. All circumferential and longitudinal welds shall be ground smooth. Material: A 516 - 70

### **Convection tubes :**

Tube size is  $\phi 50.8 \times \delta 3.25$  mm thickness. Tube specification : A 213, Carbon steel

### **Down come tubes :**

Tube size is  $\phi 133 \times \delta 6$  mm,  $\phi 108 \times \delta 4$  mm and  $\phi 89 \times \delta 4$  mm. Down comer material specification : A 106 Gr B

### **Headers :**

Headers size is  $\phi 159 \times \delta 10$  mm thickness (6") and  $\phi 219 \times \delta 12$  mm thickness (8"). Header material specification : A 106 Gr B



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**Boiler Mountings :**

The followings are supplied as standard on each boiler :-

- One            Main steam stop valve
- One            Air vent valve
- Three          Single port spring loaded safety valves for steam drum
- One            Boiler blowdown valve
- Two            Boiler gauge glass with protector glass assembly
- Two            Isolating stop valves for level controller
- Three          Isolating valves on feed water line
- Three          Non return valves on feed water line
- One            Water level controller drain
- One            Isolating valve for steam pressure gauge
- One            Isolating valve for Inspector pressure gauge
- One            Isolating valve for pressure gauge on feed water line.

All necessary valves, fittings and controls necessary for the safe operation of the boiler are provided. The items supplied shall meet the requirement of the specification as required by the fabrication Code and conform to best engineering practice. All fittings to ANSI 300# and PN40

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### **Instruments :**

Instruments provided with the boiler are :-

- a) Pressure Gauge / Transmitter
  - 1.) - 1 x steam drum pressure gauge
  - 2.) - 2 x boiler feedwater pump discharge
  - 3.) - 1 x superheated steam pressure transmitter
- b) Draught Gauge
  - 1.) 1 x FD Fan draft gauge
  - 2.) 1 x ID Fan draft indicating gauge
- c) Temperature Gauge
  - 1.) 1 x boiler flue gas temperature gauge before ID fan inlet
  - 2.) 1 x economiser outlet
  - 3.) 1 x airheater outlet (for FD air)
- d) Water Level Gauge / Transmitter
  - 1.) 2 x water level gauge, reflex glass type
  - 2.) 1 x water level transmitter for Hi/Lo water level alarm
  - 3.) 1 x water level sensor to provide signal to level controller and extra low level switch to cut off fan system
- e) Flow Transmitter / Flow meter
  - 1.) 1 x Steam flow meter
- f) Flow control valve
  - 1.) 1 x boiler feed water flow control valve
- g) Combustion control
  - 1.) 1 x steam pressure controller for ID and FD VFD control
  - 2.) 1 x chain grate governor controlled by VFD

### **Insulation :**

The boiler drum and side wall will be lagged with 3" mineral wool and firmly wired in position before cladded with aluminium sheeting. The cladding shall be well supported and neatly cloned down at ends to prevent see page occurring from boiler mountings where wetting of the insulation could occur.

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### **Electrical Equipment :**

Boiler is designed for a standard electric supply of 440 Volts, 60cycles, 3 phase, 4 wire.

### **Boiler Feed Water System :**

Comprising of 2 units of electric feed pump. Flowrate: 13m<sup>3</sup>/hr, head: 300m for 10 t/hr boiler.

### **Ceramic Type Multicyclone Dust Collector**

A ceramic type multi-cyclone dust collector is provided to reduce particulate emission level in the flue gas. The centrifuge effect inside the collector cones causes the ash to drop down into the hopper below. The ash is then continuously discharged via an airtight rotary valve which also serves to maintain a vacuum inside the hopper.

The advantages of ceramic multicyclone are: high abrasion resistant, high corrosion resistant and high temperature resistant. Therefore, we can provide guarantee on the life span of the ceramic dust collector is 5 years.

Model	: CMC
Pressure Drop	: 75 mm W. G. at 300 deg. C across arrestor
Collecting Efficiency	: The cyclone unit shall be capable of meeting the dust particle emission level of 0.3gm/Nm <sup>3</sup>

### **Electrical Panel**

An electrical panel which incorporates all the motor starters necessary for the operation of the motors supplied with the boiler.

### **Inspection**

An independent agency will carry out fabrication inspection and provide certification report on the manufacture and testing of the boiler.

### **NON DESTRUCTIVE TEST (NDT)**

All NDT are carried out in full compliance to the requirements of boiler fabrication ASME Code. Main weld seams on the drums are fully radiographed. PWHT requirements are strictly followed

### **Note :**

This specifications and drawings are tentative and we reserved the rights to vary the design or construction, provided it does not impair the efficiency and output of the unit.

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**Recommended Boiler Feed Water Condition :**

1)	Hardness	< 10 PPM
2)	Dissolved O <sub>2</sub>	0.1 PPM (max)
3)	pH value	8.5 to 9.5
4)	Free CO <sub>2</sub>	Nil
5)	Bound CO <sub>2</sub>	< 5 PPM
6)	TDS	400 PPM (max)

**Note :**

- (a) TDS value indicated is the maximum permissible. However, based on the blow down percentage, the allowable TDS should be worked out considering operating economics.
- (b) Conditioning chemicals need to be added to keep the hardness causing salts in suspension.

**Recommended Water in Boiler Specification:**

Total Alkalinity	700 PPM max.
pH	11 to 12
Phosphate (as PO <sub>4</sub> )	20 – 40 PPM
Sodium sulphite Na <sub>2</sub> SO <sub>3</sub>	30-PPM min, 50 PPM max.
Silica (SiO <sub>2</sub> )	< 0.4 PPM of caustic alkalinity
TDS	3500 PPM max.
Conductivity	1000 – 10,000 $\mu$ S/cm

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## List of motor electrical loading

### For 10 TPH Boiler

Item	Description	KW	Quantity	Total
1	FD Fan	22	1	22
2	ID Fan (with additional 250mm WG)	150	1	150
3	Feedwater pump	22	2	44
4	Chain grate	1.1	1	1.1
5	Ash discharge conveyor	2.2	1	2.2
6	Air lock	0.75	2	1.5
7	Deaerator pump	7.5	2	15
Total installed power (kW)				236
Total power usage (kW)				165

## ANNEXURE – I

### TECHNICAL DATA FOR EACH ESP

Sl No.	Description	Unit	Boiler Capacity	
			10 TPH	20 TPH
1	No. of ESP	No.	One	One
2	Gas volume	m <sup>3</sup> /hr.	33,000	48,000
3	Operating Temperature	° C	200°C	200°C
4	Inlet dust concentration	mg/Nm <sup>3</sup>	2000	2000
5	Outlet emission rate	mg/Nm <sup>3</sup>	<50	<50
6	Type of ESP	-	Horizontal flow dry type	
7	No. of fields	-	Two	Two
8	No. of gas passage	-	6	8
9	Total Field length	m	2 x 3.5M	2 x 4m
10	Field height	m	6	8
11	Specific collecting electrode area (SCA)	m <sup>2</sup> /m <sup>3</sup> /s	55	57.6
12	Collecting electrode area	m <sup>2</sup>	504	768
13	Gas velocity through ESP	m/s	0.63	0.69
14	Electrode spacing	mm	400	400
15	Pressure drop across ESP	mm WG	25 (250 pascal)	
16	Gas treatment time	sec	11	11.5
17	Operation pressure	mm WG	(-) 200	
	<b>COLLECTING ELECTRODE</b>			
19	Configuration	-	Robust strip type, arranged in series having modular design.	
20	Material	-	Cold Rolled Carbon Steel (Drawing)	
21	Thickness	mm	1.25	
22	Effective Size of each electrode (width x height)	mm x mm	500 x 6000	
23	Quantity of electrode	No.	98	144



## TECHNICAL DATA FOR ESP

	<b>EMITTING ELECTRODES</b>			
24	Configuration	-	Rigid multi-peak, bolted on pipe frame.	
25	Material	-	Stainless Steel – SS-304, thickness 1.2 mm	
26	Quantity	No.	504	768
	<b>GAS DISTRIBUTION SYSTEM</b>			
27	Configuration	-	Specially designed perforated plate at the inlet and at outlet hood.	
	<b>RAPPING SYSTEM</b>			
28	Type of rapping mechanism	-	Tumbling Hammer design, directly driven through geared motor	
29	Type of rapper control	-	Microprocessor based adjustable type	
30	Type of insulator heater	-	Ring type, thermostatically controlled	
31	Insulator material	-	Porcelain – Alumina based.	
	<b>TRANSFORMER RECTIFIER SET</b>			
32	Manufacturer (Indian)	-	ADOR POWERTRON / KRAFT POWERCON India	
33	Type	-	SCR controlled, bridge rectifier	
34	Method of cooling	-	Natural oil cooled, full wave rectification.	
35	Quantity	No.	Two (Input kVA each 8.75 )	Two (Input kVA each 13.1 )
36	Input voltage	Volt	480 / 60Hz	
37	Output voltage	kV	95 (peak)	95 (peak)
38	Output current	mA	100	150
39	Mounting type on top of roof	-	Mounting on wheels	
40	Material of construction	-	Mild Steel (corresponds to St 37.3)	
41	Plate thickness	mm	5.0	

## TECHNICAL DATA FOR ESP

	<b>DUST HOPPERS</b>			
42	Type		Inverted Pyramidal	
43	Quantity	No.	Two	
44	Material of construction	-	Mild Steel (corresponds to St 37.3)	
45	Plate Thickness	mm	5.0	
46	Valley angle	°	60 (provisional)	
	<b>THERMAL INSULATION</b>			
47	Recommended thermal insulation on ESP	-	Resin bonded wool backed with 24 SWG GI wire netting	
48	Thickness of insulation	mm	75	
49	Density	-	100 Kg/m <sup>3</sup>	
50	Cladding	-	22 SWG Plain Aluminium sheet	
	<b>GENERAL</b>			
51	<b>Guaranteed Power Consumption</b>	KW (approx.)	10	14
52	<b>Aspect ratio</b>		1 : 1.16	1 : 1.33
53	<b>Total Erection Weight excluding Thermal Insulation</b>	MT (approx.)	65	85



**DESCRIPTION OF ESP ITEMS AND DETAILS OF CONSTRUCTION**  
**(FOR SCOPE. PLEASE REFER ENCLOSED SCOPE CHART)**

**ESP HOUSING and HOPPER**

- Housing is of fabricated panels made of 5 mm thick Mild Steel plate, angle, channel and joist (as per IS – 226/IS-2062). Housing is made of welded construction consisting of wall, roof, etc. The Precipitator roof is designed to accommodate maintenance personnel access as well as for installation of equipment such as HV rectifier units, insulator housing, etc.
- Inspection doors having external latches and tightening as well as internal platform is provided for maintenance and access.
- Bottom part of housing is designed with pyramidal hopper (each having adequate storage capacity) made of 5 mm thick Mild Steel plate suitably reinforced (as per IS 226/IS-2062) and of welded construction. Hoppers are fitted with Gas baffles preventing re-entrainment of dust.
- Hopper discharge opening will be provided with manually operated slide gates followed by Rotary Air Lock with drive..
- In order to avoid distortion due to thermal expansion in housing, bearings are provided between casing and supporting structure.

**SUPPORTING STRUCTURE. PLATFORM. WALKWAYS & STAIRS**

- We have envisaged a Set of Steel Column as supporting structure for precipitator considering 2.5 m clearance below ESP hopper outlet flange and ground level.
- The Steel support is designed considering the dust weight in the hoppers, live & dead loads and seismic & wind load conditions.
- The equipment is considered with requisite platform, walkways, stairs and hand rails to provide access for operation and maintenance of Electrostatic Precipitator and its parts.

**INLET AND OUTLET FUNNEL**

- The inlet and outlet funnels of precipitator are provided with transition boxes made of 5 mm 5 mm thick Mild Steel plates and of welded construction supported from housing and to be connected with gas duct as required.

**GAS DISTRIBUTION ARRANGEMENT**

- Gas distribution arrangement consists of perforated type screen at inlet and 1 No. at outlet to ensure uniform distribution of gas over cross- section of ESP.

### **COLLECTING ELECTRODE (STRIP PLATE TYPE)**

- Collecting Electrode plates are of special design made from cold rolled Mild Steel sheet complete with mounting position to take hammer rapping anvils.
- Collecting electrodes are of strip type configuration, offering the required features of high frequency vibration. The removal of accumulated dust layers is improved by a number of parallel arranged recesses.
- The collecting Plates of each row are guided at the lower end by means of rapping bars. Electrodes permit maximum corona power to be applied for operation at peak efficiency under all conditions.

### **EMITTING ELECTRODE**

- Emitting electrodes are made of Stainless Steel strip fitted with sharp integral corona points fixed into tubular frame.
- The frame would be manufactured from mild steel round hollow section tubes. Each frame will hang vertically between parallel rows of collecting Electrodes & be supported at each end from a mild steel grip extending across the width of the casing.
- These grids will in turn, be carried by tubes from the support insulators. The whole assembly will be arranged to ensure accurate alignment of the emitting electrodes fields and prevent any movement due to gas flow.

### **RAPPING**

- The dust accumulate on the collecting plates is dislodged by means of tumbling hammers mounted on a slowly rotating horizontal shaft. The tumbling hammers, the weight & consequently the rapping energy which varies accordingly to the requirement, hit the rapping bars of the collecting plates.
- The dust accumulated on the emitting electrodes is also dislodged by means of tumbling hammers hitting an impact on anvils of the emitting electrode frame work.
- The rapping geared motor of the collecting / emitting electrode system have driving units which are mounted outside the precipitator housing.
- The rapping of the Collecting Electrodes & Emitting Electrodes, are intermittent; and programmed by microprocessor based synchronous programmer mounted in the Control Panel.
- With this type of rapping, collected dust is effectively sheared from the plate / surface and thus remains close to the plates while falling toward the dust storage hoppers. This feature limits re- entertainment ensuring high collecting efficiency is maintained.

### **HIGH VOLTAGE SUPPORT INSULATOR**

- High Voltage Insulators made of high alumina based porcelain are used to support Emitting Electrodes and grids, situated on roof of precipitator housing and are placed in housings.

### **INSULATOR HEATER**

- To prevent moisture condensation on insulators, 1 kW, 480 V, 2 wired insulator heaters are used for heating each high voltage support insulator. Heaters will encircle periphery of insulator at the bottom.
- Heaters will be controlled individually by thermostat of suitable range.

### **HOPPER HEATER**

- Thermostatically controlled Hopper heaters are provided at bottom of each ESP hopper to eliminate stickiness of dust inside hopper sides enabling free flow of dust through discharge point.

### **RAPPING GEARED MOTOR**

- Horizontal foot mounted type geared motors are provided for rapping system of collecting electrode and Emitting electrode at ESP inlet. The offered motors will be suitable for 480V, 60 Hz, 3 Phase AC supply.

### **SAFETY INTERLOCK**

- Since Electrostatic Precipitator (ESP) works on high voltage electrical field, necessary safety precautions are to be provided during operation of the equipment. For this purpose, whole of the electrical equipment and precipitator will be interlocked both mechanically and electrically making it possible to enter into any charged portion of ESP unit which part has been shut down and safely earthed. Inspection doors are fitted with safety interlocking arrangement. The locks are of special type, i.e. when the door is open, key will be trapped in the lock and after closing the door and locking it, key will be released.

### **T/R SET WITH CONTROL PANEL**

- Each transformer rectifier set is a robust weatherproof unit constructed from sheet steel, mineral oil filled and natural convection ONAN cooled. It is designed to comply with IP-55 protection.
- The T/R set control panel is constructed from sheet metal, floor mounted, vertical freestanding with IP-31 class of protection.
- The microprocessor based automatic voltage controller is housed in the TR control panel.
- Each T/R control panel shall be equipped with primary AC Voltmeter/Ammeter, Precipitator DC Voltmeter/Ammeter, Mains / HT on Indication, circuit breaking devices, spark rate meter, LT Bus bar control switches, indicators, visual and audio alarm overload and earth fault protection, current limiting relays etc.



- ☐ The control Panel will provided with interlocks, automatic regulator & other protecting devices for safe and efficient operation of the ESP as well as safety for operating personnel.
- ☐ The Transformer Rectifier will be equipped with silica gel breather, Marshalling box, Conservator, Oil level gauge, HV bushing, thermometer, HV DC voltage / Current feedback assembly etc.
- ☐ One no. microprocessor based rapper controller for adjusting rapping frequency of rapping mechanism is provided.

#### **HIGH LEVEL INDICATOR**

- ☐ Each ESP hopper will be provided with RF type Switch for high dust level indication.

#### **ESP AUXILIARY CONTROL PANEL**

- ☐ Control panel shall be non-drawout, vertical free standing, compartmentalized pattern with IP -52 class of protection having feeders for rapping geared motors, insulator heaters, and hopper heaters.
- ☐ These feeders shall be equipped with SFU, contactors, thermal overload relays etc. for control of motors.
- ☐ The heater feeders shall have SFU units.
- ☐ The control panel will be made of CRCA steel sheet.

#### **THERMAL INSULATION**

- ☐ One lot of light resin bonded machine made machine stitched mattress with wire netting on one side to be supplied as thermal insulating material is accordance with IS:8183.
- ☐ Plain Al sheet shall be used as cladding material or ESP housing, Hopper & inlet/outlet connecting funnel.

### 450 KW STEAM TURBINE GENERATOR SET



Single stage steam turbine 4700 rpm, gear reducer 4700 rpm to 1800 rpm, 480 v generator  
Inlet steam: 22 bar/423 °F, Exhaust steam: 3.5 bar, 10TPH.

Wood Peak 200 electronic Governor, Matrix vibration monitor, RTDs.

Generator breaker and control panel, Auxiliary power breaker, Lighting power transformer.

### **LV Generator Control Cabinet**

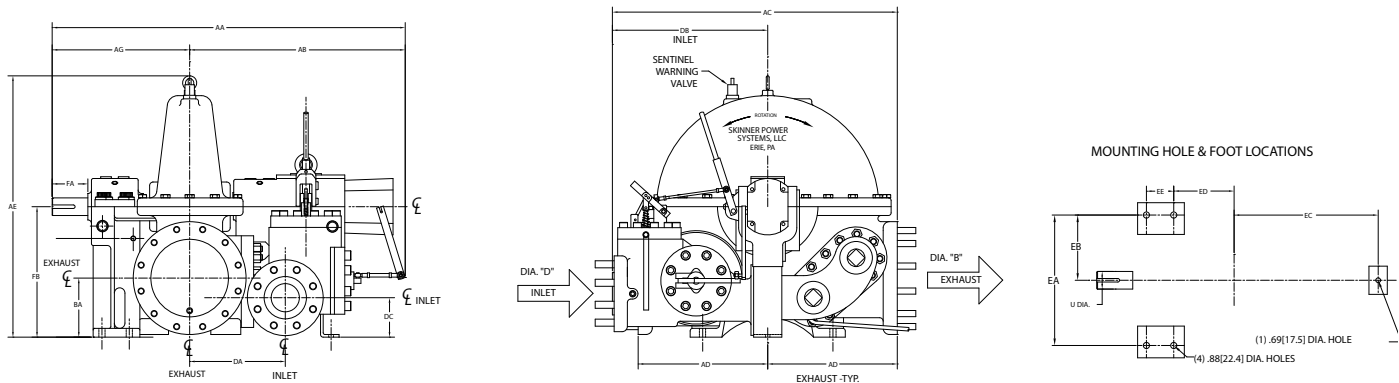
Quantity offered: One (1) Unit

480/277V 60 Hz, 3-Phase Service Voltage, 800A Copper Main Bus bars, 100% rated Neutral and 25% rated Ground bar. Free standalone One (01) cell with the following dimensions: 80"H x 32"W x 40"D, Bottom Incoming and outgoing connections, Front Access, Single Door NEMA 1 enclosure, 12G Carbon Steel, Finish RAL-7035 Light gray textured interior and exterior.

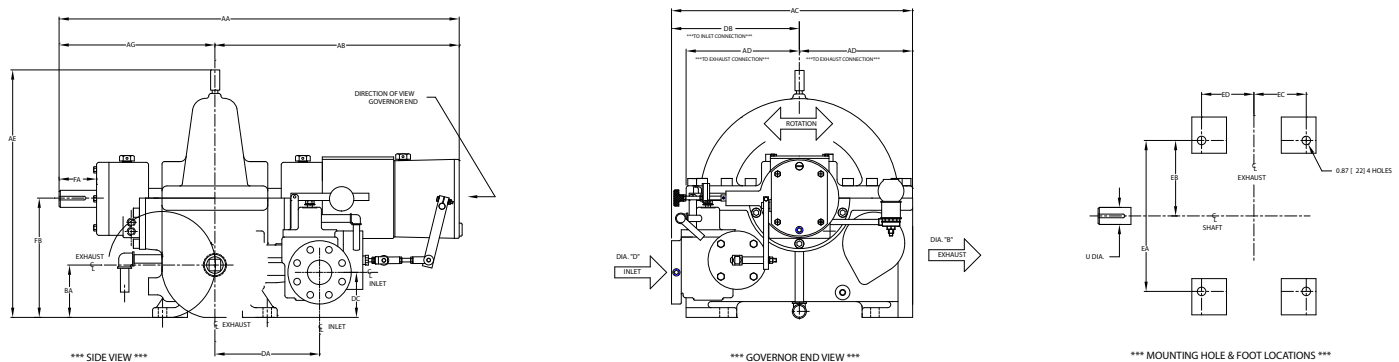
#### **One (01) ACB bay containing:**

- Lugs for 500mcm cable incoming and outgoing connections.
  - Copper Incoming and outgoing Bus bars, rated current 800A.
  - One (1) 800A Air Circuit breaker Hyundai Brand three (3) poles, with the following features:
    - U Series Model UAN08A 85kA @480V
    - Fix type
    - Shunt trip, close coil and motor control (24Vdc)
    - One (1) Digital Trip Relay A type with LSIG protection/Thermal
    - 3 phase current metering and LCD Display
    - Modbus RTU/RS485 Communication
    - Event/Fault Recording
  - One (1) AutoStart Genset Controller Brand Deep Sea Model DSE8610.
    - Comprehensive synchronizing & load sharing capabilities
    - Built-in governor and AVR control
    - Base load (kW export) functionality
    - Voltmeter, Frequency meter, Ammeter
    - Generator power (kW, kV Ar, kV A & pf) monitoring
    - Hour meter and Fuel level meter
    - Overload (kW & kVAr)/ Reverse power (kW & kVAr)/Unbalance
    - load protection
    - Low oil pressure/ High coolant temperature/ Low fuel level/ Rpm protection
    - Battery charger alternator fault
    - Emergency stop button
    - Audible alarm
    - Terminal board for auxiliary connections
    - RS232 & RS485 Port and Ethernet communication
    - Can Bus reading Port
  - Three (3) 800:5A Metering CTs ANSI metering Class: 0.3 (B0.1) UL Recognized, meets the requirements of ANSI/IEEE C57.13.
  - 100% rated Neutral and 25% rated Ground Copper Bus Bar
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Model	S-18	SB-18	S-23	SB-23	S-28
Maximum Inlet Gauge Pressure (PSI/Bar)	900/60	900/60	900/60	900/60	900/60
Maximum Inlet Temperature (°F/°C)	900/480	900/480	900/480	900/480	900/480
Maximum Exhaust Gauge Pressure (PSI/Bar)	150/10	250/16	150/10	150/10	150/10
Speed Range (RPM)	800/5000	800/5000	800/5000	800/5000	800/5500
Bearing Type	Sleeve	Ball	Sleeve	Ball	Sleeve
Wheel Pitch Diameter (IN/mm)	18/457	18/457	23/584	23/584	28/711
Approx. Maximum Rating (HP/kW)	400/300	400/300	900/666	900/666	1800/1350
Approx. Shipping Weight (LB/kg)	1100/500	1100/500	1800/816	1800/816	2800/1270



FRAME SIZE		S-SERIES APPROXIMATE DIMENSIONS — INCHES/MILLIMETERS																			
		OVERALL									FOOTPRINT					SHAFT			CONNECTIONS		
		AA	AB	AC	AD	AE	AG	BA	DA	DB	DC	EA	EB	EC	ED	EE	DIA U	FA	FB	ASA	
																				B	D
18		42.14 1070	26.14 664	29.32 745	11.38 289	26.00 660	16.00 406	5.75 146	10.78 274	15.06 383	4.50 114	12.75 324	6.38 162	18.00 457	6.88 175	3.19 81	1.75 44	4.38 111	12.63 321	6"	3"
		42.09 1069	26.09 663	33.69 856	13.38 340	32.12 816	16.00 406	5.75 146	12.63 321	19.69 500	4.75 121	7.00 178	2.25 57	6.56 167	8.19 208	5.00 127	1.75 44	4.63 118	14.63 371	6"	4"
23		51.25 1302	31.75 806	40.20 1021	18.38 467	37.06 941	19.50 495	8.38 213	13.56 344	21.82 554	5.72 145	18.50 470	9.25 235	20.44 519	8.69 221	3.88 98	2.50 64	5.06 129	18.50 470	10"	4"
		51.25 1302	31.75 806	42.16 1071	18.38 467	37.06 941	19.50 495	8.38 213	14.18 360	22.65 575	6.00 152	18.50 470	9.25 235	20.44 519	8.69 221	3.88 98	2.50 64	5.06 129	18.50 470	10"	6"



FRAME SIZE	SB-SERIES APPROXIMATE DIMENSIONS — INCHES/MILLIMETERS																		
	OVERALL										FOOTPRINT				SHAFT			CONNECTIONS	
	AA	AB	AC	AD	AE	AG	BA	DA	DB	DC	EA	EB	EC	ED	DIA U	FA	FB	ASA	
																		B	D
18	45.88	29.88	26.69	11.63	26.00	16.00	5.75	10.78	15.06	4.50	15.50	7.75	5.38	5.38	1.75	4.38	12.63	6"	3"
	1165	759	678	295	660	406	146	274	383	114	394	197	137	137	.44	111	311		
23	40.06	24.06	33.69	13.38	32.12	16.00	5.87	12.63	19.69	4.75	20.75	10.38	5.50	5.50	1.75	4.63	14.63	6"	4"
	1017	611	856	340	816	406	149	321	500	121	527	264	140	140	.44	118	371		







# MAGNA**MAX**DVR®

## *Generator Ratings:*

*kW 118 – 2370 (60 Hz)*

*kVA 136 – 2400 (50 Hz)*



## MARATHON ELECTRIC

GENERATORS

ISO 9001:2000 Certified

# Product Features

**Permanent Magnet Generator . . .** ensures 300% short circuit current during fault conditions and provides the regulator with input power isolated from load distortions.

**Unirotor Construction . . .** incorporates single piece rotor laminations, a die cast rotor core and amortisseur windings into an integrated rotor assembly. The field winding is wet layer wound to the rotor assembly with thermo setting epoxy for high mechanical and electrical integrity.

**Digital Voltage Regulator . . .** is encapsulated for reliable performance in all environments. The DVR@2000E includes voltage regulation to .25%, three phase RMS sensing, adjustable volts/hertz underspeed protection, advanced engine unloading algorithms, integrated paralleling capabilities, and over-excitation /over-voltage protection. A VAR-PF controller is available as an optional feature.

**Large Conduit Box . . .** provides ample space for easy connections and allows load line access from all sides, top, or bottom.

**Exciter and PMG Mounting . . .** provides easy access and serviceability. The PMG is mounted external to the generator bearing. The exciter is externally mounted on 570 and 740 frame generators.

**Class H Insulation System . . .** utilizes an unsaturated polyester varnish for optimal insulation life and superior moisture protection.

A tropical insulation is added for increased environmental protection. A vacuum pressure impregnated insulation system is an available option.

**Shielded Heavy-Duty Bearings . . .** resist contamination and give a minimum B-10 life of 40,000 hours. Regreasing provisions are available on all generators.

**Enhanced Ventilation . . .** created by a high efficiency fan and optimized internal air flow patterns, maximizes heat transfer and minimizes hot spot differentials for extended winding life.

**Fully Guarded . . .** for operator safety and generator protection, no rotating or electrically energized parts are exposed. All openings are covered by louvers or screens.

**Optimized Windings . . .** provide low reactances and exceptional motor starting capability. The stator windings utilize a 2/3 pitch to minimize harmonic distortion and facilitate parallel operation.

**Design Specs and Agency Approvals . . .** are important at Marathon. All **MAGNAMAX<sup>DVR</sup>** units meet NEMA MG1-22, BS5000, CSA C22.2, IEC 34-1 and VDE 0530 requirements. Marine versions are available to meet American Bureau of Shipping, Lloyds, Det Norske Veritas, or Nippon Kaiji Kyokai requirements.





## Innovation Performance Reliability



### Unirotor Construction

- Single Piece Rotor Laminations
- Aluminum Die Cast Rotor Core



### DVR2000E

- Patented PMG Powered
- Digital Voltage Regulator

Since its market introduction, Marathon Electric's **MAGNAMAX<sup>DVR</sup>®** has been a technology leader and proven performer. The **MAGNAMAX<sup>DVR</sup>®** generator line offers as standard a permanent magnet generator excitation system, exceptional transient performance and strong motor starting capability, and utilizes the industry's first digital voltage regulator.

Each **MAGNAMAX<sup>DVR</sup>®** features the exclusive DVR2000E digital voltage regulator providing .25% regulation and three phase RMS sensing.

These outstanding features make **MAGNAMAX<sup>DVR</sup>®** the ideal generator for voltage critical applications such as:

- Telecomm Networks
- Commercial Buildings
- Hospitals
- Computer Centers
- Airports
- Distributed Power

**MAGNAMAX<sup>DVR</sup>®** meets the demands of today's changing market:

- Supporting non-linear loads (UPS systems and variable frequency drives)
- Providing unprecedented voltage regulation in the presence of harmonic distortion caused by non-linear loads
- Easy access and serviceability
- Providing low reactance design which minimizes the harmonic voltage distortion caused by non-linear loads
- Constructed for extended life
- Reliable performance

**60**  
**Hertz**

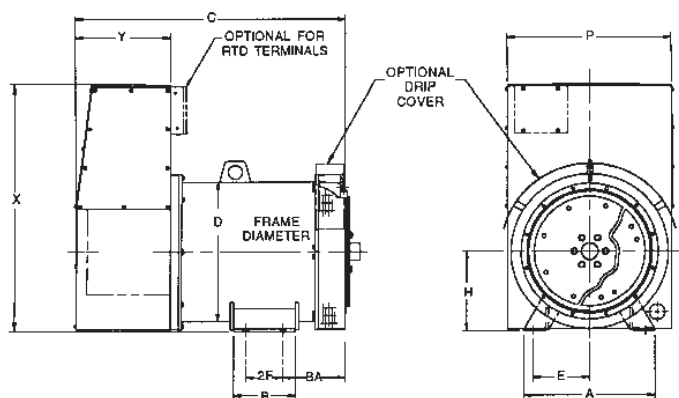
**4-Pole,  
Three Phase**

**240Y or 480Y Volts**  
**(10-12 Leads)**  
**480Y Volts (4-6 Leads)**

1800 RPM  
NEMA Class H Insulation  
40°C Ambient  
0.8 Power Factor Lagging  
DVR®2000E AVR with  
PMG Excitation

**MAGNAMAX<sup>DVR</sup>**

Base Model	Net Wt. (lbs.)	No. of Leads	Voltage	kW Rating @ Designated NEMA Rise				
				Continuous			Standby	
				NEMA B 80°C R/R	NEMA F 105°C R/R	NEMA H 125°C R/R	NEMA F 130°C R/R	NEMA H 150°C R/R
431RSL4005	1280	12	240Y/480Y	126	145	154	155	160
431RSL4007	1370	12	240Y/480Y	140	165	175	175	185
432RSL4009	1550	12	240Y/480Y	172	203	215	215	226
432RSL4011	1570	12	240Y/480Y	192	221	231	231	250
432RSL4013	1600	12	240Y/480Y	200	235	250	250	263
432RSL4015	1810	12	240Y/480Y	230	275	285	285	300
432RSL4017	1830	12	240Y/480Y	230	275	292	300	310
433RSL4019	2340	12	240Y/480Y	305	350	375	375	415
433RSL4021	2365	12	240Y/480Y	330	380	405	405	440
572RSL4024	2730	10	240Y/480Y	380	450	475	475	505
572RSL4025	2730	12	240Y/480Y	380	450	475	475	505
572RSL4027	2840	12	240Y/480Y	440	500	515	515	560
572RSL4028	3050	10	240Y/480Y	445	535	560	560	610
572RSL4029	3050	12	240Y/480Y	445	535	560	560	610
572RSL4030	3110	10	240Y/480Y	485	575	600	600	645
572RSL4031	3110	12	240Y/480Y	485	575	600	600	645
573RSL4032	3400	10	240Y/480Y	570	680	700	700	765
573RSL4033	3400	12	240Y/480Y	570	680	700	700	765
573RSL4034	3620	10	240Y/480Y	585	710	750	750	810
573RSL4035	3620	12	240Y/480Y	585	710	750	750	810
574RSL4036	4080	10	240Y/480Y	670	800	825	825	900
574RSL4037	4080	12	240Y/480Y	670	800	825	825	900
574RSL4038	4240	4	480Y Only	720	860	915	920	970
575RSL4044	5000	4 Bars	480Y Only	800	975	1050	1060	1130
741RSL4045	5490	12	240Y/480Y	865	1030	1080	1100	1100
740RSL4046	5200	4 Bars	480Y Only	950	1120	1200	1220	1250
742RSL4048	6300	4 Bars	480Y Only	1000	1200	1260	1300	1300
742RSL4049	6300	12	240Y/480Y	1000	1200	1260	1300	1300
742RSL4050	7230	4 Bars	480Y Only	1220	1430	1500	1500	1520
743RSL4052	7800	4 Bars	480Y Only	1310	1600	1700	1750	1750
744RSL4054	8600	4 Bars	480Y Only	1500	1850	1960	2000	2000
744RSL4056	9740	4 Bars	480Y Only	1700	2010	2160	2210	2260
744RSL4058	9740	4 Bars	480Y Only	1760	2100	2270	2320	2370
Form Wound Coil Designs								
744FSL4060	7300	4 Bars	480Y Only	1200	1430	1500	1500	1500
744FSL4062	8300	4 Bars	480Y Only	1500	1800	1900	1900	1900



430 – 570 – 740 Frame

## Dimensions in inches and (millimeters)

**MAGNAMAX<sup>DVR</sup>**

ALL DIMENSIONS ARE APPROXIMATE: Contact factory for full dimensional data

Frame Size	A	B	BA	C	D	E	2F	H	P	X	Y	MAX Net Wgt. lbs. (kg)
431	21.00 (533)	10.00 (254)	10.00 (254)	38.40 (975)	22.64 (575)	9.00 (229)	6.00 (152)	13.00 (330)	26.51 (673)	39.77 (1010)	15.21 (386)	1370 (623)
432	21.00 (533)	10.00 (254)	10.00 (254)	43.40 (1102)	22.64 (575)	9.00 (229)	6.00 (152)	13.00 (330)	26.51 (673)	39.77 (1010)	15.21 (386)	1830 (832)
433	21.00 (533)	10.00 (254)	10.00 (254)	49.40 (1255)	22.64 (575)	9.00 (229)	11.00 (279)	13.00 (330)	26.51 (673)	39.77 (1010)	15.21 (386)	2365 (1075)
572	22.50 (572)	15.00 (381)	11.50 (292)	51.52 (1308)	27.64 (702)	10.00 (254)	11.00 (279)	15.50 (394)	30.77 (782)	42.64 (1083)	17.21 (437)	3110 (1411)
573	22.50 (572)	24.00 (610)	11.50 (292)	58.02 (1474)	27.64 (702)	10.00 (254)	20.00 (508)	15.50 (394)	30.77 (782)	42.64 (1083)	17.21 (437)	3620 (1642)
574	22.50 (533)	24.00 (610)	11.50 (292)	65.02 (1651)	27.64 (702)	10.00 (254)	20.00 (508)	15.50 (394)	30.77 (782)	42.64 (1083)	17.21 (437)	4240 (1923)
575	22.50 (533)	24.00 (610)	11.50 (292)	69.27 (1759)	27.64 (702)	10.00 (254)	20.00 (508)	15.50 (394)	30.77 (782)	42.64 (1083)	19.21 (488)	5000 (2268)
740	33.00 (838)	27.00 (686)	12.00 (305)	71.37 (1813)	27.64 (702)	15.00 (381)	23.00 (584)	19.00 (483)	30.77 (782)	51.45 (1307)	19.21 (488)	5200 (2359)
741	33.00 (838)	27.00 (686)	12.00 (305)	65.81 (1672)	34.24 (870)	15.00 (381)	23.00 (584)	19.00 (483)	38.02 (966)	51.45 (1307)	21.24 (539)	5490 (2490)
742	33.00 (838)	27.00 (686)	12.00 (305)	72.81 (1849)	34.24 (870)	15.00 (381)	23.00 (584)	19.00 (483)	38.02 (966)	51.45 (1307)	21.24 (539)	6300 (2858)
743	33.00 (838)	41.00 (1041)	12.00 (305)	79.31 (2014)	34.24 (870)	15.00 (381)	37.00 (940)	19.00 (483)	38.02 (966)	51.45 (1307)	21.24 (539)	7800 (3538)
744	33.00 (838)	41.00 (1041)	12.00 (305)	85.81 (2180)	34.24 (870)	15.00 (381)	37.00 (940)	19.00 (483)	38.02 (966)	51.45 (1307)	21.24 (539)	9740 (4418)

Note: Connection boxes shown are furnished as standard product. Consult factory for optional connection boxes.



**Your Independent Power Source  
for the 21<sup>st</sup> Century!**

P.O. Box 8003  
Wausau, WI 54402-8003 USA

[www.marathonelectric.com](http://www.marathonelectric.com)

Phone: 715-675-3359  
Fax: 715-675-8026

SB370 6029J/2k/11-07/SK/TP



# **MAGNAMAXDVR® GENERATORS**

## **RANDOM WOUND**

### **TYPICAL SPECIFICATION**

The generator shall be manufactured by Marathon Electric Manufacturing Corporation and of the MagnaMAXDVR® design. It shall meet all requirements of NEMA MG-1, Parts 16 and 22, in design, performance and factory test procedures. The generator and regulator will be C.S.A. listed. The regulator shall be factory wired and tested with the generator.

#### ***CONSTRUCTION AND BEARINGS***

The unit shall be fully guarded per NEMA MG-1-1.25.4 as a minimum. Optional drip covers can be requested to meet requirements for IP-22 and IP-23 on stock units. Other ratings are available as special build-up designs and should be requested from the factory.

Cast iron end brackets and fabricated steel frames shall be used.

Bearings shall be pre-lubricated, double shielded, ball type, single row conrad, C3 fit with provisions for adding and/or changing grease. The ability to grease through extended supply and relief tubes is available as an option. Minimum B-10 bearing life shall be 40,000 hours for single bearing units.

The grease utilized shall be Polyrex EM or equivalent.

#### ***PMG EXCITATION SYSTEM***

The generator shall be equipped with a 300/250 Hz permanent magnet generator excitation system. Both the PMG and the rotating brushless exciter shall be mounted outboard of the bearing. The system shall supply a short circuit support current of 300% of the rating for 10 seconds. The rotating exciter shall use a three phase full wave rectifier assembly with hermetically sealed silicon diodes protected against abnormal transient conditions by a multi-plate selenium surge protector. The diodes shall be designed for safety factors of 5 times voltage and 3 times current.

#### ***INSULATION SYSTEM***

The insulation system shall be UL recognized meeting the construction requirements of UL-1446 and shall be suitable for submission as a component for UL2200 certification. The insulation system of both the rotor and stator shall be of NEMA Class H materials or better and shall be synthetic and non-hygroscopic. The stator winding shall be given multiple dips and bakes of varnish, plus a final coating of epoxy for extra moisture and abrasion resistance. The rotor shall be layer wound with thermosetting 100% solids epoxy between each layer, plus a final coating of epoxy for moisture and abrasion resistance.

## **MAIN ROTOR**

The main rotating field shall be of Unirotor® construction, consisting of one piece, four pole laminations. Dovetails, cross bolts and other pole to shaft connection means are not acceptable. In addition, the amortisseur winding and field pole coil supports shall be integrally die cast with the rotor laminations to form a unitized rotor core. Fabricated and welded or brazed amortisseur windings and coil supports are not acceptable. The rotor core shall be shrunk fit and keyed to the shaft.

The rotating assembly shall be dynamically balanced to less than 2 mils peak to peak displacement, and shall be designed to have an over speed withstand of 125% of rated speed for 15 minutes when operating at stable rated operating temperature.

## **STATOR WINDING**

The stator winding shall be of 2/3 pitch design to eliminate the third harmonic and shall incorporate a one slot skew to minimize slot harmonics. Windings shall be random wound and lashed at the end turns to provide superior mechanical strength.

## **TEMPERATURE RISE**

The temperature rise of both the rotor and stator shall be measured by the resistance method and shall be in accordance with the applicable sections of NEMA MG-1, Parts 16 and 22, BS-5000, or C.S.A. C22.2, for the type of service intended.

## **VOLTAGE REGULATOR**

The DVR2000E+ voltage regulator shall be a digital, microprocessor design with solid state voltage build-up. No voltage build-up relay or other relays are acceptable. The unit shall be encapsulated for humidity and abrasion protection. The regulator shall include 1/4% regulation, true volts per hertz operation with adjustable cut in, loss of sensing continuity shutdown, over excitation shutdown, three phase RMS sensing, over voltage protection, and provisions for parallel operation.

## **PERFORMANCE**

The voltage regulation shall be 1/4% from no load to full load and 5% frequency variation. Regulator drift shall be less than 1/2% per 72°F (40°C) ambient temperature change. The voltage regulator shall be a static-type using non-aging silicon controlled rectifiers, with electromagnetic interference suppression to MIL-STD-461 C, part 9, when mounted in the generator conduit box.

The waveform harmonic distortion shall not exceed 5% total RMS measured line to line at full rated load.

The TIF factor shall not exceed 50.

## ***VENTILATION***

The generator shall be self-ventilated and have a one-piece, cast aluminum alloy, unidirectional internal fan for high volume, low noise air delivery. Air flow shall be from opposite drive end through generator to drive end. The exciter shall be in the air flow.

## ***CONDUIT BOX***

Load connections shall be made in the front end mounted conduit box. The generator construction will allow connection to the load through the top, bottom or either side of the conduit box.

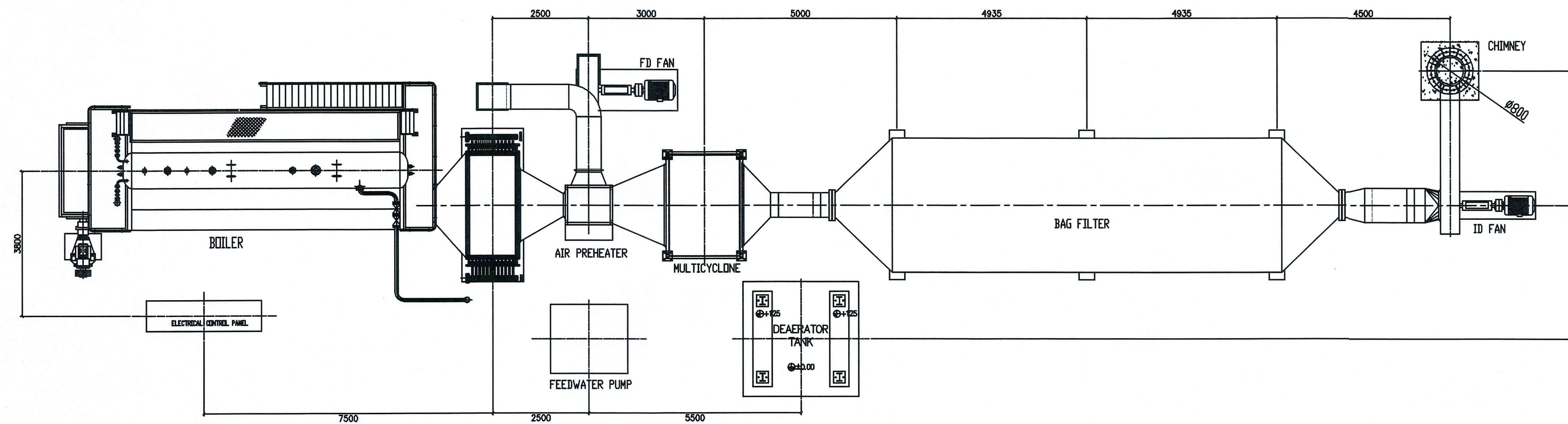
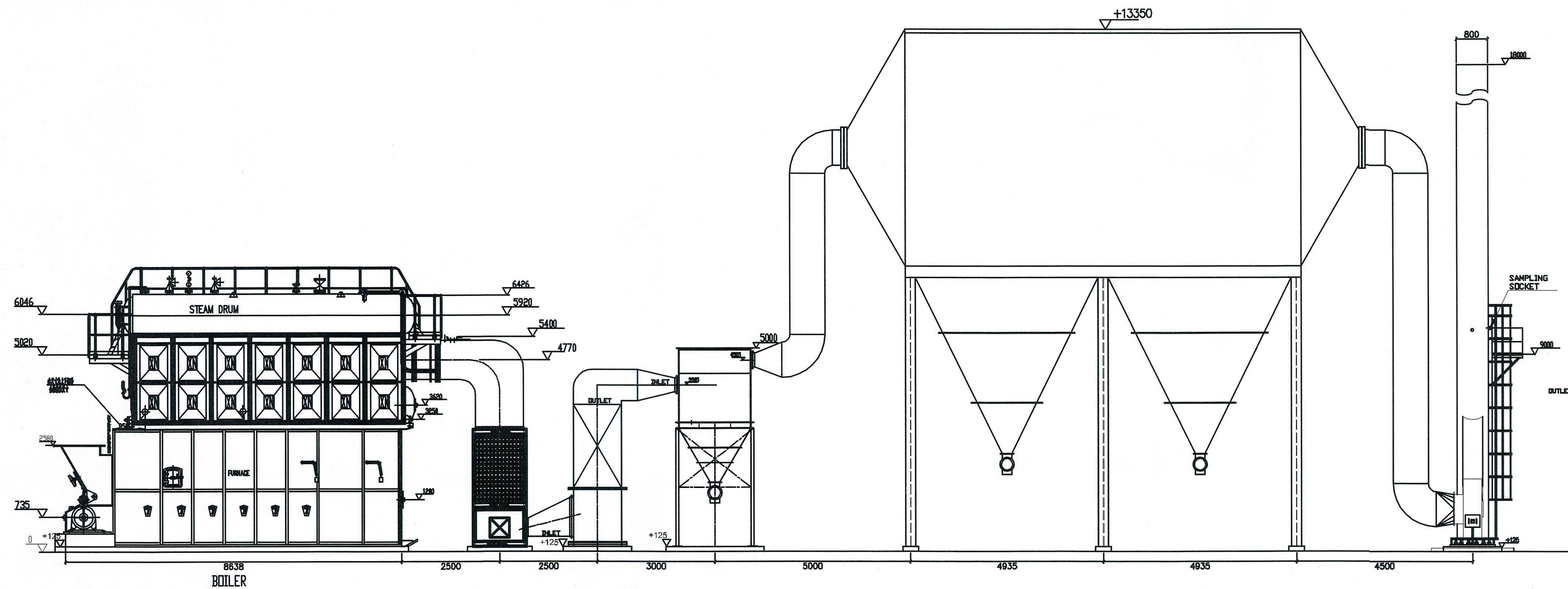
The conduit box shall be constructed of heavy gauge sheet steel, capable of supporting up to 240 pounds of accessory control equipment. The conduit box shall contain two compartments; one housing the rotating rectifier and PMG; and the other the connection area and regulator. This is to separate the rotating elements from the load connection and voltage regulator adjustments.

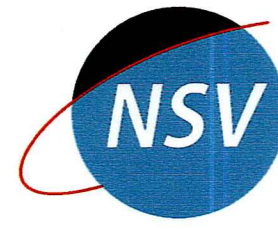
The regulator shall be mounted on the inside of the conduit box panel allowing access to adjust the regulator through a swinging dust cover from the outside of the conduit box, therefore avoiding the higher voltage generator terminals on the inside of the conduit box.

## ***VERIFICATION OF PERFORMANCE***

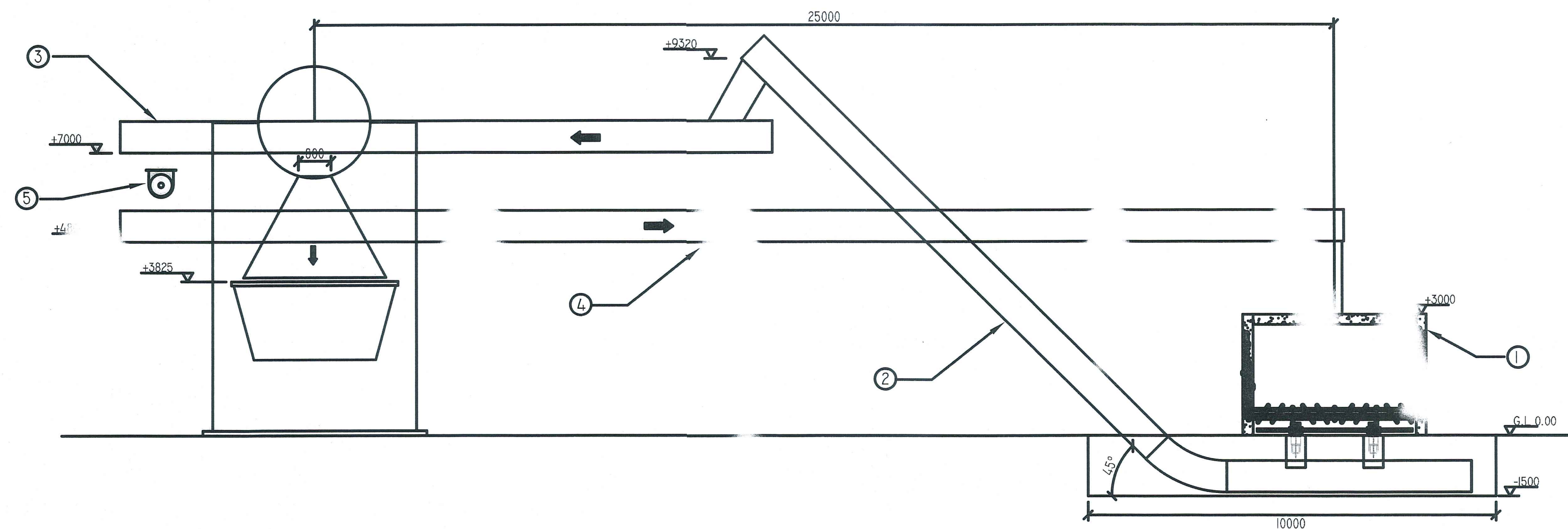
All certified performance and temperature rise test data submitted by the generator manufacturer are to be the result of the actual test of the same or duplicate generators. Temperature rise data shall be the result of loaded, rated power factor heat runs at the rated voltage and hertz. All performance testing shall be done in accordance with MIL-STD-705 and/or IEEE Standard-115.



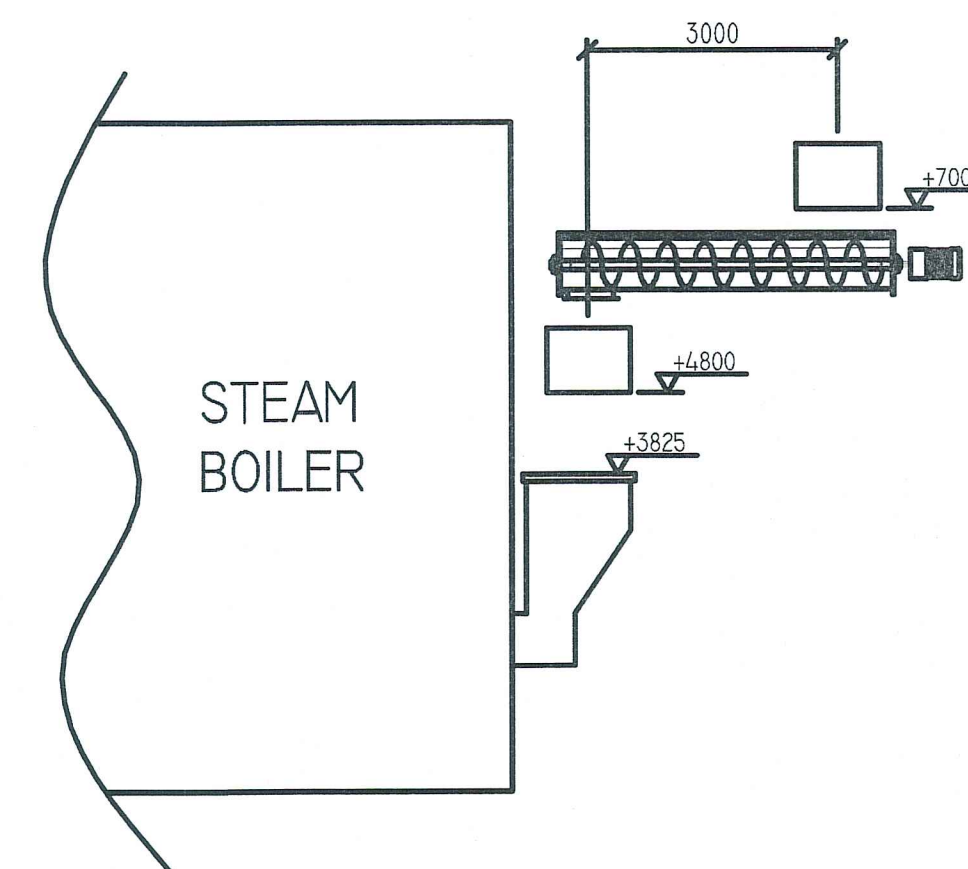


CLIENT: NSV ENERGY, LLC CANTON GA	PROJECT: 10 TPH STEAM BOILER	DRAWING NO: PP-MX-18-SZL10-GA-0001
 <b>NSV Energy, LLC</b> <a href="http://www.nsvenergy.com">www.nsvenergy.com</a> <a href="mailto:sales@nsvenergy.com">sales@nsvenergy.com</a>		TITLE: PROPOSED GENERAL ARRANGEMENT OF 10 TONNES PER HOUR STEAM BOILER C/W CHAIN GRATE AND BAG FILTER
N.T.S	28 MAY 2018	1 OF 1
SCALE	DATE:	SHEET

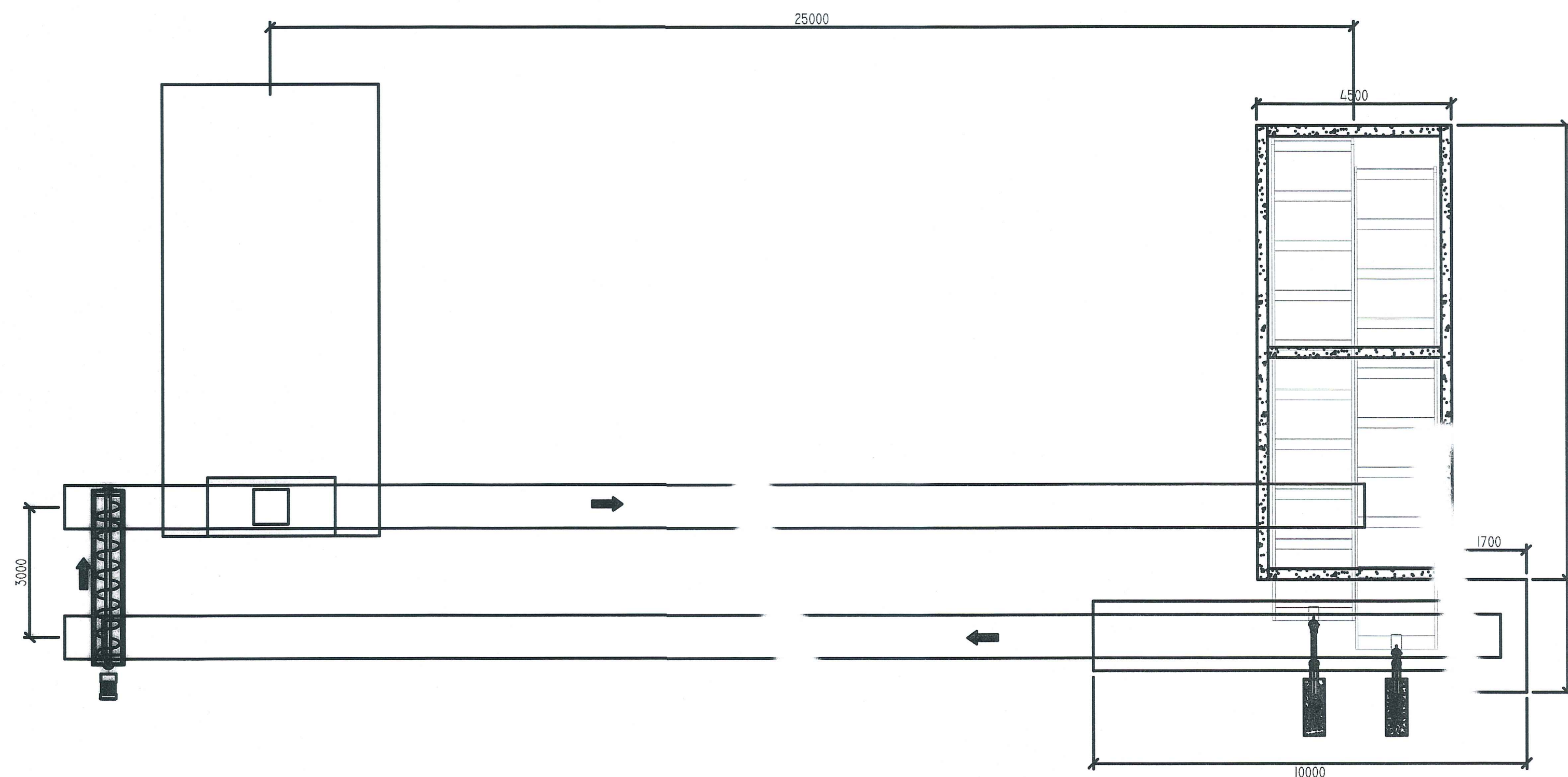




FRONT VIEW



SIDE VIEW



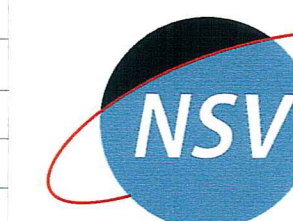
PLAN VIEW

5	SCREW CONVEYOR Ø500 x L:4000	1
4	SCRAPER BAR CONVEYOR W:900 x H:780 x L:30000	1
3	SCRAPER BAR CONVEYOR W:900 x H:780 x L:16000	1
2	SCRAPER BAR CONVEYOR W:900 x H:780 x L:22000	1
1	MOVING FLOOR W:4000 x H:3000 x L:11000	1
ITEM	DESCRIPTION	QTY

CLIENT:  
NSV ENERGY, LLC  
CANTON GA

PROJECT:  
FUEL FEEDING SYSTEM

DRAWING NO:  
PP-MX-18-FFS-GA-0001-RI



**NSV Energy, LLC**  
[www.nsvenergy.com](http://www.nsvenergy.com)  
[sales@nsvenergy.com](mailto:sales@nsvenergy.com)

TITLE:  
GENERAL ARRANGEMENT LAYOUT OF FUEL  
FEEDING SYSTEM

N.T.S. 25 MAY 2018  
SCALE DATE:

1 OF 1  
SHEET