UKRAINE
LIMITED LIABILITY COMPANY
Boiler Factory «Kriger»

INSTALLATION AND OPERATING MANUALS
KVM250-00.00.000 IE
Hot Water Heating Boiler
KVm – 2.50
GP-11 IED

Heat Capacity 2000 kW

ES U 25.2-35299597-009:2012

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ZHYTOMYR
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1. INTRODUCTION

This operation and maintenance technical description refer to automatic wood fired boilers, supplied by LLC Boiler Factory "Kriger". The description takes into account all parts, supplied by LLC Boiler Factory "Kriger" except overhead traveling crane and a gripper which can be used for some installation sites for fuel storage (provided with a separate description).

This technical description does not contain technical descriptions of specific installation elements which have technical sheets, which require separate familiarization, especially in terms of security, operation and maintenance peculiarities.

Part of this technical description requires referring to the system specifications which the boiler is intended for.

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2. GENERAL PROVISIONS

2.1 Maintenance staff

Maintenance staff shall be trained and responsible for operating boiler on wood. The staff needs to know different technical descriptions of the system operation and maintenance and be also able to refer to the detailed technical passports of different units and parts. Special operation requirements shall be complied with in the boiler room. The boiler service log shall be daily filled, the schedule of the required works shall be observed.

2.2 Persons with an access to the boiler room.

Should unauthorized persons have access to the boiler room or work in proximity to the power station, the person responsible for the boiler operation shall inform them about all possible risks and dangers.

2.3 Breathing in Dust Hazards.

Dust (wood, ash) can have a negative impact on the health of the people: to wear protective masks is mandatory for all personnel assigned to the power stations provided by, LLC Boiler Factory" Kriger".

2.4 Inflammability Hazard.

Some equipment shells in the boiler room can be hot: the staff shall be warned about it. The ignition reducing procedures shall be carried out.

2.5 Noise Hazard.

The existing high noise level in the boiler room is hazardous: the operating organization shall inform individuals who often come to the boiler room, as well as carry out noise reducing procedures.

2.6 Equipment Protection.

The equipment of LLC Boiler Factory "Kriger" shall be installed indoors, protected from extreme weather conditions.

The consumer must take all measures to prevent the vibrations transmission onto the equipment as well as avoid external influences.

Maintenance operations must be performed in accordance with the requirements of manufacturers. Any repair or modification must be done with adherence to regulatory requirements and be agreed with LLC Boiler Factory "Kriger".

2.7 External Ignition Hazard.

The user shall take all precautions to ensure that in the case of fire, the equipment shall be protected from water.

2.8 The need for Safety Valves Installation.

Safety valves shall be installed on the boiler and maintained in operating conditions to ensure its good operation.

2.9 Venting and Drainage Outlets.

To avoid any risks of accidents, the heat exchanger shall have venting and drainage outlets.

2.10 Unsteadiness Hazards.

The consumer shall take measures to protect the power station from unsteadiness or swaying.

3. POWER STATION DESCRIPTION

The number of heating lines		1
Boiler capacity		2000 KW
Cooling agent		water
Maximum coolant temperature		125 ºC
Flow		68 m3/h
Pressure		____ bar
Efficiency output		88%
Guaranteed atmospheric emission	Dust	150 mg/Nm3 dry 11% d'O2
	CO	250 mg/Nm3 dry 11% d'O2
	NO2	500 mg/Nm3 dry 11% d'O2
	COV	50 mg/Nm3 dry 11% d'O2
Fuel characteristics	Origin	
	Fuel Heating Value (FHV)	From 4210 KWh/t for the wood with the 15% moisture content, up to 1930 KWh/t for the wood with the 55% moisture content
	Moisture Content	from 15 to 55%
	Density	From 200 for the wood with the 15% moisture content, up to 400 kg/m3 for the wood with the 55% moisture content
	Amount of dust	3% (<1 mm)
Fuel Storage		Concrete Platform
Fuel Withdrawal Method from the Storage		Push Floor Conveyor
Fuel Transportation to the Boiler		Conveyor
Fuel Supply to the boiler		Plunger
Furnace Type		Mechanic Furnace Bar
The combustion air distribution		Primary, Secondary Air
Primary Water Heating		No
Flue-Gas Recirculation		Yes
Heat Exchanger Type		Three-Channel Heat Exchanger
Air Compressor		Yes

4. DESCRIPTION OF THE POWER STATION OPERATION

4.1 Fuel Withdrawal from the Storage.

4.1.1 Process.

4.1.1.1 Operating Peculiarities

Fuel withdrawal from the storage is performed with the Push Floor conveyor. Sweepers placed on the Storage floor beams, pick up fuel and carry it to the conveyor which feeds the fuel into the boiler. The fuel seizure and feeding are performed as required and specified by the program.

4.1.1.2 Push Floor Traffic.

Each section is driven by a hydraulic cylinder. One cylinder is designed for each section. The former is driven by a single hydraulic power unit with a pump. The hydraulic station is equipped with a distributing canal with two solenoid-operated valves for each cylinder, which are designed to feed oil to one or the other side of the cylinder, according to the desired movement direction. The duration of the cylinder movement in either direction is set on the touch screen of the control Cabinet.

Traffic time of a Push Floor section Cylinder 1, (3,5) forth and cylinder 2, 6) back	1/10 sec
Traffic time of a Push Floor section Cylinder 1, (3,5) back and cylinder 2, 6) forth	1/10 sec

4.1.2 Possible settings

For satisfactory operation of the fuel withdrawal system adherence to the following conditions is necessary: i) compliance with fuel specifications, and ii) adjustment of the boiler according to fuel type.

Some fuels are easier to go onto the conveyor, therefore the Push Floor needs to be configured for delayed extraction in relation to the conveyor speed. This setting is called “Push Floor delayed stroke”.

In contrast, if loading the fuel onto the conveyor takes more effort, the sooner loading of the conveyor in relation to its full release shall be configured. The duration and the delay time between the Push Floor and conveyor speed are configured on the touch screen. This setting is called "Stop sweepers delay ". It is necessary to monitor the conveyor operation, as overloading can lead to pressing (visual control for several cycles is necessary to define the need to adjust these settings).

Note: fuel feeding speed is set by the button "Sweepers’ time". Adjust the settings if it exceeds the time required for feeding the boiler.

4.1.3 Safety

4.1.3.1 Safety Measures.

It is forbidden to enter the fuel storage during the Push Floor conveyor operation. The access door to the storage, as well as the conveyor inspection door, must be closed during the conveyor operation.

Safety measures while working with hydraulic systems are specified in the hydraulic station passport.

4.1.3.2 Possible Errors.

4.1.3.2.1 Excess hydraulic pressure.

The hydraulic station is equipped with a safety valve which drains the oil into the tank when the oil pressure reaches the level of 200 bar.

4.1.3.2.2 Error "shutting down fuel storage hydraulic station ".

If the power supply to the hydraulic system engine is ceased, the error message "Shut-down of the fuel storage hydraulic station" appears on the control Cabinet touch screen. In this case, check the engine efficiency in order to find possible mechanical jamming before resuming its work.

After the troubleshooting, arm the corresponding thermal switch and close the error message on the controller display, and press the red break-down reset button.

4.1.3.2.3 Error "Emergency Stop of the Fuel Supply"

The emergency stop button is located near the cylinders. When the button is pressed, the system will stop operating. The error message "Emergency stop of the fuel supply" will appear on the control Cabinet touch screen.

To resume the system operation, reset the "Emergency stop of the fuel supply" button by turning it in the direction indicated by the arrows on the top of the button. Close the error message on the front panel display of the control Cabinet, and press the red break-down reset button.

4.2 Fuel Conveying.

4.2.1 Description

Fuel from the storage is fed to the boiler by means of a fuel chain conveyor with sweepers. The fuel is loaded onto the conveyor by means of Push Floor sliding scrapers. The conveyor is driven by the engine when detecting an empty feed hopper and at the end of the plunger feed.

4.2.2 Possible settings

The fuel conveyor speed is controlled by the company personnel. It is prohibited to change this setting without the consent of the company.

4.2.3.1 Safety Measures

It is forbidden to get inside the conveyor during its operation. The access door to the storage, as well as opening the conveyor inspection door, is prohibited.

4.2.3.2.1 Error «Variable Speed Controller of the Fuel Conveyor»

In the case of an error of the fuel conveyor variable speed controller, the system will stop operating. The "Variable Speed Controller of the Fuel Conveyor" error message will appear on the touch screen. To fix the error (also visible on the of the speed controller screen) refer to the technical description of the variable speed controller.

To fix the error, press the "RESET" button on the front panel of the variable speed controller, then close the error message on the controller display, and press the red break-down reset button.

4.2.3.2.2 Error "Fuel Conveyor Rotation"

There is a position sensor installed on the fuel conveyor bottom, that detects the passing of the conveyor chains while its normal operation. In the absence of the chain movement, the sensor gives an error message "Fuel Conveyor Rotation".

Possible reasons for the error:

- Damage to the position sensor,
- Chain break,
- Engine damage.

4.2.3.2.3 Error "Fuel Conveyor Over current"

The engine electricity current can be measured. The over-current or excess voltage is most commonly the result of the conveyor jamming. At this error, the conveyor stops, moves backward for 5 seconds, then moves forward again. There can be 3 suchlike runs. Should the excess voltage not disappear, the conveyor will stop and the touch screen will show the "Fuel Conveyor Over current" error message.

Should that happen shut down the boiler operation, turn off electrical equipment, then open the door at the conveyor's bottom, find the cause of the jamming.

It can be the following:

- Foreign objects (stones etc.) or too long pieces of wood, then manual cleaning of the conveyor is needed
- A too large portion of fuel, then revise the settings of the fuel feeding system,
- Bad chain pull-up –tighten-up.

To fix the error, press the "RESET" button on the front panel of the variable speed controller, then close the error message on the controller display, and press the red break-down reset button

4.2.3.2.4 Error “Fuel Conveyor Overheating”

An automatic thermostatic valve is installed on the inside bend of the conveyor, which is connected to an external water supply network. Temperature excess in the conveyor expands the alcohol in this probe, thus enabling the water admission to the conveyor.

The fuel conveyor is also equipped with a temperature probe; the measured indicators are visible on the control Cabinet touch screen. If the temperature exceeds the set limits, the boiler stops operating and the touch screen shows the "Fuel Conveyor Overheating" error message. In this case, check what happened in the conveyor (control

through the conveyor inspection door), and in the case of ignition or smoke, wet the fuel with water. In the case of a fire call the Fire Department.

The problem can occur in the case of:

- Overpressure in the furnace throat,
- The boiler shutdown without the release of the fuel supply line (hopper and conveyor) from the fuel.

After the failure recovery close the error message on the controller display and press the red break-down reset button

4.3 FUEL FEEDING OF THE BOILER

4.3.1 Operation Procedure

A plunger, driven by a hydraulic RAM at certain time intervals pushes the fuel into the feed channel. Fuel delivery frequency is defined automatically according to the boiler capacity. Fuel transition through the feed channel (always filled) is the last stage before fuel combustion in the furnace.

In the normal position, the plunger moves forward to close the feed channel to prevent penetration of flame from the combustion chamber into the fuel storage. For loading, the plunger first moves back to make room for a portion of the fuel in the channel; it then pushes fuel up to the "forward" mark.

The plunger moving back, the protection against flame penetration is performed by a shutter, which is located on the plunger chute immediately after the conveyor. The shutter is driven by a simple cylinder and in a default position, it is closed. The shutting is performed by the counterweight, which ensures a fire barrier, even in the absence of electrical supply.

For fuel feeding its certain amount is needed in the plunger chute. Therefore, when the load is over and the plunger has begun its movement, the shutter opens and the conveyor starts to fill the plunger chute. Two infra-red level sensors inform about the sufficient amount of fuel in the plunger chute, then the conveyor stops and the shutter closes. The level sensors are periodically cleaned with compressed air.

Shutter and plunger cylinders operate from the same hydraulic unit (200 bar). Position sensors determine the "open and closed" plunger positions as well as the shutter "open" position. They determine of the end of the movement.

4.3.2 Possible settings

Fuel feeding frequency, which is required to the nominal power for each fuel type, is indicated on the touch screen. It depends on the volume and heat capacity of fuel and can be calculated depending on the moisture content and density of the fuel. Fuel feeding frequency can be automatically calculated to reduce power.

4.3.3 Safety.

4.3.3.1 Safety Measures

The chute is equipped with an inspection door, which must be closed when the system is operating.

4.3.3.2
Possible Errors

4.3.3.2.1 Hydraulic Pressure Excess

The hydraulic station is equipped with an adjustable safety device for oil return to the reservoir when the pressure is exceeding 200 bar.

4.3.3.2.2 Error "End of Plunger Movement" and "End of Shutter Movement"

Some time is provided for the plunger to reach the "open" and "closed" position. While its movement is not over, the system will go on supplying oil under pressure. If the time for this procedure is exceeded, the plunger will start a new cycle: the movement back and forth. If the plunger still does not reach the end point of its movement after three attempts, the unit will stop and the touch screen will show the "End of Plunger Movement" error.

Likewise, the shutter has a certain time and three attempts to reach the end point of its opening movement. In the case of failure, the touch screen shows the "End of Shutter Movement" error.

Possible causes of such errors for the plunger and the shutter are:

- End of movement sensor damage,
- Incorrect sensor operation,
- Hydraulic leak in the cylinder,
- A defective solenoid valve coil,
- Defective automatic relay.

4.3.3.2.3 Error "No Oil in the Plunger Hydraulic Unit" is not available at this station.

There is a mark in the hydraulic station to detect the oil level. Too low oil level provokes the hydroelectric power station shut-down and the "No Oil in the Plunger Hydraulic Unit" error message on the touch screen.

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.3.3.2.4 Error "Plunger Hydraulic Unit Shutdown"

If the electric supply of the hydraulic unit engine is disconnected, the error "Plunger Hydraulic Unit Shutdown" message appears on the touch screen. In this case before switching back the engine, check whether the engine is operational, and without any mechanical jams.

After the troubleshooting, arm the corresponding thermal switch and close the error message on the controller display, and press the red break-down reset button.

4.3.3.2.5 Error "No Fuel in the Fuel Feed Chute".

The time when the chute can be empty is limited. If the level sensors do not detect filling the chute at least once over 2 fuel feeding cycles, the touch screen will display the "No Fuel in the Fuel Feed Chute" error message, but the boiler will not stop operating. After the error occurs for the 5^{th} time, the boiler will stop. This means that the chute cannot be filled over time, between the two feeds, so the amount of fuel entering the furnace is not enough to ensure a given power. To solve this problem, check the entire chain of fuel supply, to ensure that there are no jams, and if necessary, make an adjustment of fuel supply into the feed chute.

After eliminating the malfunction, the display controller closes the error messages and presses the red reset button accident.

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.3.3.2.6 Error "Fuel Pressing in the Feed Chute"

The time when the chute can be filled is limited. If the level sensors do not detect emptying the chute at least once over 2 fuel feeding cycles, the touch screen will display the " Fuel Pressing in the Feed Chute ", error message, but the boiler will not stop operating. After the error occurs for the 5^{th} time, the boiler will stop. This indicates incorrect operation of level sensors: if the chute is really filled, check the operation and connection of the level sensors; if the chute is empty, perhaps the sensors are dirty and need manual cleaning when the unit is not operating; check the operation of the pneumatic cleaning system of the sensors.

After the troubleshooting, close the error messages on the controller display and press the red break-down reset button.

4.3.3.2.7 Fire detection and error "Overheating in the Fuel Feed Chute"

The plunger and the shutter are two fire-protective appliances. Therefore, the automatic system prevents that the plunger is in the back position at the same time when the shutter is open.

A self-supporting thermostatic faucet connected to an external water supply network is installed in the chute on an irrigation distribution device. Temperature rise to 45 ^{o}C will expand the alcohol in the sensor, thus enabling water admission to the chute.

The chute has also a sensor that constantly measures the temperature: this temperature is indicated on the touch screen. The temperature rise over 45^{o}C will cause the "Overheating in the Fuel Feed Chute" error message, fuel feeding hold up, shutter closing, two cycles of the plunger and, finally, shut down of the boiler with the exception of the exhaust fan which will go on operating for a certain period of time. The control engineer shall check what happened in the chute (through the inspection door) and in case of ignition or smoke wet the fuel in the chute with water; in case of a fire – call the Fire Department

After the troubleshooting, close the error messages on the controller display and press the red break-down reset button.

4.4 FURNACE

4.4.1 Operation Procedure

4.4.1.1 Combustion

The fuel in the furnace is subjected to different transformations.

- The moisture contained in the fuel is evaporated due to the high temperature in the furnace (white smoke emission).

- When all the moisture evaporates pyrolysis produces fugitive power gas inside the furnace. Wood is the fuel that contains about 70% of volatile substances.

- The solid fraction, left after the gas release by pyrolysis, (or carbonaceous residue) burns down the furnace. By the end of the furnace bar, combustion is over, and there remains only ash.

- Volatile fraction of fuel released by the pyrolysis will burn in the gas phase. This combustion starts in the furnace above the furnace bar and then continues in the first circulation pass of the flue gas (or the combustion chamber). This combustion space is quite spacious for a long presence of fractions flying from the furnace and dwindling in the burning flames.

To enable such combustion, the injection of the combustion-supporting air is provided as follows:

Primary air is blown under the furnace bar, to different sections in accordance with the different phases of fuel transformation, associated with the bar (drying, pyrolysis, combustion of carbonaceous residues). Systems, provided for burning very wet fuels, can be equipped with a fuel pre-drying system: hot gasses rush into the lower part of the furnace and mix with air fed under the bar at the furnace inlet. Some systems, on the contrary, feed the cold gasses to the flue gas processing level to mix with air. It regards the "diluted primary air": the aim is to create an air flow sufficient for cooling the furnace bar, without increasing the total amount of oxygen under the bar to enable layer burning.

-Secondary air is blown through the holes at the top of the boiler, at the level of the inlet to the first row of the tubular heat exchanger: this air ensures the combustion of pyrolysis gasses. The holes are equipped with plugs, adjustable manually from outside the boiler, their number and placement can also be adjusted.

The number of fans is defined on the basis of the maximum required flow, i.e. the maximum capacity. For the capacity lower than the nominal one, the air flow is reduced with the help of registers and speed variations, connected with the fans (according to the installation). Secondary air flow is also adjustable depending on the desired amount of oxygen at the boiler outlet.

Providing combustion in several stages is a "multi-staged combustion" technique, which is used to achieve more effective combustion with the least amount of pollutants. Combustion occurs not only at the furnace bar level; the temperature there is lower, which reduces the production of thermal nitric oxide

Combustion products from the first combustion zone complete burning at the secondary air injection level, thus enabling the living flame; there occurs the transformation of CO into CO2.

Moreover, for the significant reduction the of nitrogen oxide (Nox) formation, some boilers are equipped with flue gas recirculation device (mainly boilers for burning very dry fuels or fuels containing the elements that contribute to the formation of Nox, for example,

fuel rich in nitrogen): after the processing stage flue gases are forced back to the boiler, above and all along the furnace bar. This injection of low-oxygen gasses enables the reduction of nitric oxide formation.

4.4.2 IED operation for the Directive 2000/76/EC

To full fill the requirements of the Directive 2000/76/EC, a progressive two-stage forced draught gas burner is attached to the boiler.

To maintain the required temperature of the wood burning process, a gas burner with a control system is installed on the boiler, which is interconnected with the process control system of the boiler.

In normal boiler operation, the burner is switched off.

The temperature of the burning process of the wood is controlled and, when it decreases below a permissible value, a command is given to start the burner.

When the boiler operating mode is restored, the burner is switched off.

Forming in the furnace combustion stage a temperature of 850-890°C is achieved by supplying secondary air into the region located underneath. Lower rows of concrete arches further discharge countercurrent to the movement of the fuel. Then the combustion stage enters the secondary channel (constricted section), which is arranged between the upper and lower rows of the concrete arches where the temperature reaches about 920-950°C. Then, the combustion directs into the third channel which is between the upper vaults and the shell boiler furnace. Here, the temperature is slightly lower at about 850°C. If the boiler temperature will not achieve the 920-950°C in the second channel between the upper and lower arches the installed gas burner starts automatically. The proposed three-way burner allows you to set the boiler to achieve combustion for two seconds at a temperature no less than 850°C.

4.4.2.1 SAFETY

4.4.2.2 Safety Measures

For the Safe operation of the gas burner, please refer to the document "GULLIVER_RG5DF.pdf" - Section 3.

4.4.3 Furnace Construction

As the fuel is supplied by the plunger, the fuel is collected in the feed channel, and then fed into the furnace with the sliding bar. The furnace bars are arranged on a high chromium cast-iron beam and are arranged in rows. Every second row is set on a sliding frame which enables the back and forth movement: these rows are thus sliding while the other rows are stationary. This system allows the fuel spread over the furnace bar:

- When the sliding frame is moving forward, the moving beams slide on the stationary ones and push the fuel forward,
- When the sliding frame goes back, the moving beams slide under the stationary ones: the fuel, on the sliding beams, goes onto the stationary ones.

The sliding frame is driven by the hydraulic cylinder. The cylinder stroke is controlled by two sensors which are located at the travel border to determine the passage of the bar. For boilers with the large furnace bar area, the bars are divided into sections, which are driven separately from each other.

The furnace side frame and the roof are covered by thermally insulating concrete. The presence of such material allows maintaining sufficient temperature for efficient combustion in the furnace.

The furnace draft is provided by the exhaust fan (see description).

4.4.3 POSSIBLE SETTINGS

All settings depend on the fuel type.

4.4.3.1 Furnace Bar Settings

The movement of the furnace bar rows is periodic. This period can be adjusted in the "Furnace Bar Travel Time", the shutdown time is changed depending on the required boiler capacity. This time can be adjusted to different data:

- "The stroke expectation of 20%" for capacity equal to or lower than 20%,
- "The stroke expectation of 40%" for capacity between 21 and 40%,
- "The stroke expectation of 60%" for capacity between 41 and 60%,
- "The stroke expectation of 80%" for capacity between 61 and 80%,
- "The stroke expectation of 1000%" for capacity between 81 and 100%.

These adjustments must ensure the progressive motion of the fuel in the furnace with the appropriate speed:

- If the fuel is moving forward too quickly, the combustion of carbonaceous residues may not end at the end of the bar
- If fuel is moving forward too slowly, burning can end too quickly and a significant part of the bar will not be covered with fuel, the drying, pyrolysis and combustion stages will be ill-performed due to the uneven fuel allocation.

Using the adjustments it is possible to achieve uniform fuel distribution in the furnace. This option is necessary to change the type of fuel.

It is also possible to move the bar manually.

During the thermostatic boiler shut-down, the furnace bar work like at the automatic mode, but with a longer holding time.

4.4.3.2 Settings of the combustion air injection

Depending on the system type, fan speed changes the air flow by means of variations and/or valves.

For primary air, the fan(s) speed and the number of open valves provide the minimum or maximum power; these settings are done for the average capacity in the automatic mode.

For secondary and tertiary air, the fan speed in automatic mode is set for the average capacity. The number of open valves changes depending on the set parameters of oxygen, which is measured continuously at the exhaust fan outlet. The minimum and maximum valve opening are set for different capacities.

The correct adjustment must be based on the following principles:

- A minimum flow of primary air shall be maintained since it protects the furnace bar with cooling.

- Air distribution shall enable staged combustion: if the primary air flow is too high, the combustion occurs at the furnace bar level; the number the secondary and tertiary air valves is too small for the second phase of efficient combustion. Too much primary air also contributes to the particles flying in the furnace.

- The number of open secondary air valves shall enable regulating the amount of oxygen.

- The adjustment shall be performed with frequent visual monitoring of the furnace through the window on the furnace door. This will enable watching the combustion in the furnace and check the combustion stage: there shall not be white flames (too much primary air), the flame shall appear at the top of the furnace and the combustion zone must be clearly visible.

It is recommended to use measuring instruments for the adjustment; they will enable testing the amount of carbon monoxide, carbon dioxide and oxygen in flue gasses. To make accurate measurements it is necessary to wait for the uniform operation of the boiler.

At the boiler shutdown (either thermostatic or because of an error), to ventilate the combustion area, the primary air valves will close and the secondary air valves will open to a predetermined value.

4.4.4 SAFETY

4.4.4.1Safety Measures

The furnace shell is hot; do not lean on them or place heat-sensitive equipment next to it.

Before start boiling system, purge air channels and exhaust duct.

4.4.4.2 Errors

4.4.4.2.1 Hydraulic Pressure Excess

The hydraulic station is equipped with an adjustable fuse for draining oil into the tank if the pressure exceeds 140 bar.

4.4.3.2.2 Error "End of the Forward/Backward Bar Movement”

Some time is provided for the furnace bar to achieve positions forward/backward (defined by sensors). If this time is exceeded, the touch screen will display indications of the time changes. This will not stop the boiler operation and the bar will continue its movement in the opposite direction until reaching the other sensor; there can be 3 attempts like this. After three unsuccessful attempts, the boiler stops and the touch screen shows the error "End of the Forward/Backward Bar Movement".

Possible reasons for the error are as follows:

- damaged end of a movement sensor,
- malfunctioning of the end of a movement sensor,
- Oil leak in the cylinder,
- Defective solenoid valve coil,
- Defective automatic relay output
- Furnace bar blockage with slag.

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.4.4.2.3 Error "No Oil in the Furnace Bar Hydroelectric Power Station" is not provided in this power station.

There is an oil gauge on the hydroelectric power station. Low oil level causes the hydroelectric power station shut down and the appearance of the «No Oil in the Furnace Bar Hydroelectric Power Station» error message.

4.4.4.2.4 Error «Excessive Furnace Bar Stop»

If the furnace bar stops for too long, the boiler will stop operating and the touch screen will display the error "Excessive Furnace Bar Stop".

It can be helpful to stop the furnace bar movement immediately after the boiler operation start, but the bars operate in an automatic mode in the default operation phase,

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.4.4.2.5 Error "Primary Air Speed Variation 1" and other on the speed variation errors.

In the case of a speed variation error (for example speed variation of the primary air fan 1), the boiler will stop and the "Primary Air Speed Variation 1" error message appears on the touch screen. Consult the technical description of the speed variation, to identify the error (it is visible on the speed variation console).

To eliminate the errors press the "RESET" button on the front panel of the frequency converter and close the error messages on the controller display and press the red break-down reset button.

4.4.4.2.6 Error "Emergency Boiler Shutdown"

The stop button is placed on the electrical cabinet door. When enabled, the unit will stop and the touch screen will show the "Emergency Boiler Shutdown" error message.

To resume the power station operation, turn the "Emergency Boiler Shutdown" button in the initial position with a key. Close the error message on the front panel display of the control Cabinet, and press the red break-down reset button.

4.4.4.2.7 Error "Furnace Door is Open"

Different doors providing access to the furnace must always be closed during the power station operation. The doors are equipped with sensors and if any of them detects the doors opening, the boiler will stop and the touch screen will show the "Furnace Door is Open" error message. If there are several doors, the open door is specified on the screen.

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.4.4.2.8 Errors "High Oxygen Level" and "Low Oxygen Level"

If the amount of oxygen measured at the smoke exhauster outlet is below the limit defined by LLC Boiler Factory "Kriger", there will be the "Low Oxygen Level" error message. Likewise, the oxygen level above the limit provokes the "High Oxygen Level" error message

These errors do not stop the boiler operation; make sure that the air inlet valves are not blocked (manually), that the combustion settings corresponds to the fuel type, that the probe placed at the exhaust outlet is functioning correctly (watch out, it's hot).

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.4.4.2.9 Error "High Temperature in the Furnace"

At normal operation, the temperature in the furnace remains within certain limits: in the case of passing the upper limit (usually 1100 ^{o}C), the boiler will stop and the corresponding error message will appear on the touch screen. It is necessary to visually monitor the combustion process in the furnace.

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.4.4.2.10 Error "Low Temperature in the Furnace"

At normal operation, the temperature in the furnace remains within certain limits: in the case of passing the lower limit (typically 500 ^{o}C), the corresponding error message will appear on the touch screen. The boiler will not stop, but you need to visually monitor the combustion process in the furnace.

4.4.4.2.11 Error "Mini Flue Gases"

As soon as the temperature measured at the heat exchanger outlet falls below a certain limit (LLC Boiler Factory "Kriger" usually sets as 105-120 ^{o}C depending on the fuel type), the boiler will stop and the touch screen will show the "Mini Flue Gases" error message. This usually means that the fire in the furnace is damped as a result of:

- Insufficient combustion control, especially at low power,
- lack of fuel; check the entire fuel supply chain.

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.4.4.2.12 Error "Excessive Stop of Mini Flue Gases Check"

Because of the mini flue gasses button on the touch screen, there is no need to check the temperature of the fumes, but when starting the boiler. But if this control is not performed for a long time, the power station will stop and this error will appear on the touch screen.

After the boiler process stabilization, enable automatic control of mini flue gasses in the settings menu

4.4.4.2.13 Error "Pressure Excess in the Furnace" and "Excessive Draft in the Furnace"

If the exhaust fan does not provide sufficient draft in the furnace one of these, errors will occur. In this case make sure that:

- The pressure sensor is not blocked (for example with ash),
- There are no problems (leaks) in the pneumatic joints of the boiler and pressure switch,
- Analog pressure probe measurement is correct
- Inlet air valves are not blocked,
- There is no extra fuel in the boiler,
- There are no significant damages on chimneys, especially between the heat exchanger and the filter.

"Pressure Excess in the Furnace" will cause the boiler shutdown, and the "Excessive Draft in the Furnace" error will appear on the touch screen to warn that the boiler does not operate at its optimal mode, but it will not stop its work.

If this problem occurs too often, adjust the fan speed variation (LLC Boiler Factory "Kriger").

After the troubleshooting, close the error message on the controller display and press the red break-down reset button.

4.5 HEAT EXCHANGER

4.5.1 Operation Procedure

The heat exchanger is placed above the furnace and consists of 3 passes. The heat exchange in the combustion chamber (surrounded by a water film) is basically radiative, and convective in the smoke flue exchanger.

4.5.2 Settings

4.5.2.1 Water Inlet Temperature

This temperature is adjustable.

4.5.3 SAFETY

4.5.3.1Safety Measures

The pumps providing water circulation in the boiler must be ready for operation before the boiler start-up.

Water quality must be consistent with the recommendations of the heat exchanger designer (see relevant technical guidance)

4.5.3.2 Errors

4.5.3.2.1 Error «Water Overheating»

If the inlet water temperature exceeds the limits, the boiler will stop and the touch screen will show the "Water Overheating" error message. The reasons may be as follows:

- lack of the boiler irrigation, it is necessary in this case to ensure the normal operation of circulation pumps,
- The produced boiler power exceeds the network capacity: if the network consumption is below the technical minimum boiler capacity, it is necessary to stop the boiler.

Before re-starting the boiler check the overheating sensor (cool it down from outside).

4.5.3.2.2 Errors «Low Inlet Water Temperature" and "Low Outlet Water Temperature"

If the outlet water temperature drops below the pre-set limit and it stays low for a quite long time, a corresponding error message will appear on the touch screen. At first, the boiler will not stop, as this does not represent an immediate danger, but it is necessary to comply with the minimum temperature to secure the equipment. If this error remains unfixed for a long time, the boiler will stop.

4.5.3.2.3 Error "Low Water Pressure in the Boiler"

If the water level falls below the level defined by the manufacturer it will result in a lack of pressure and correspondingly an error will occur and the boiler will stop. In this case, it is necessary to check the entire chain responsible for the water pressure.

Before you restart the boiler check the no/low-pressure sensor (after fixing the problems with pressure).

4.5.3.2.4 Errors "Low Power Input", "Low Power Input, Boiler Shutdown", "Low Power, Restarting Prohibited for 5 hours" `

If the difference between the inlet and outlet water temperatures is too small at minimum power, an error "Low Power Input" will occur, but the boiler will not stop. After some time (45 Min with a temperature difference of 4-6 ^{O}C at 20-30% of nominal power), an error "Low Power Input, Boiler Shutdown" will occur and the boiler will stop. Once re-enabled, the boiler can set into operation, but it is possible to restart the boiler maximum twice within 5 hours. When this error occurs for the third time within 5 hours, the boiler will not restart for 5 hours and the touch screen will display the "Low Power, Restarting Prohibited for 5 hours" error message.

The purpose of these precautions is to protect the equipment because otherwise, the weak mode of operation results in the flue pipes condensation.

4.5.3.2.5 Error "The Heat Exchanger Door Opened"

The door giving access to the heat exchanger must always be closed during the boiler operation. It is equipped with a terminal sensor which detects the end of the door movement: if the sensor indicates that the door is open, the boiler will stop and the touch screen will show the "The Heat Exchanger Door Opened" error message.

4.6 WET ASH REMOVAL

4.6.1 Operation Procedure

The ash falling into the end of the grate is removed by means of a wet ash removal system, which consists of a chain conveyor with the blocks placed on it. This conveyor transfers the moistened ash to the ash box.

The lower part of the conveyor is located under the grate and submerged in water. The level of water ensuring tightness (prevents entry of air into the system) is controlled by a level sensor, the electro-valve controls the filling of the system with water.

The ash removal system can work in manual mode.

4.6.2 Settings

The periodicity of movement of the ash removal conveyor is regulated by two parameters:

- "Ash removal time": duration of movement,
- "Waiting for the movement of ash removal": the time interval between two movements.

The speed of the system is controlled automatically, but in manual mode, it is possible to adjust the speed with the button "Speed of the ash conveyor manually".

4.6.3 Security

4.6.3.1 Security measures

It is forbidden to penetrate the conveyor when it moves. For this purpose, the sighting doors of the conveyor during the operation of the boiler must be closed.

4.6.3.2 Errors

4.6.3.2.1 Error "Transducer of ash conveyor from the furnace"

In the event of an error on the inverter, a fault appears on the screen that indicates a change in the set value and does not stop the boiler. If this error continues with the time set by the manufacturer, the boiler will stop and the error "Too long ash removal stop" will appear on the touch screen. In this case, you need to refer to the technical passport of the converter to determine the error, which will be visible on the converter console.

4.6.3.2.2 Error "Monitoring the rotation of the ash conveyor"

To determine the normal operation of the ash conveyor, a motion sensor is installed. In the event of an interruption in the chain of the conveyor or an engine failure, the error "Turnover of the ash conveyor" appears on the screen, but this error will not cause the boiler to stop. In the case of a long time (the manufacturer's specified) the indicated error, the error "Stop the ash conveyor stops too long" will appear on the screen and the boiler will stop.

4.6.3.2.3 Error "Over current of ash conveyor"

The electrical current absorbed by the ash conveyor motor is measured. Over current is the result of the blocking of the conveyor: if the over current is determined, the conveyor will stop, move in the reverse direction for 3 seconds, and then resume its normal

forward motion. Three such actions can be taken before the error "Overflow of ash conveyor" appears on the screen and the boiler stops.

In this case, stop the installation, turn off the electrical cabinet and give new instructions for control. Then you can open the inspection door of the conveyor to check for breakage. It can be:

- A large accumulation of ash, in this case, you need to check the regularity of the conveyor and, if necessary, adjust it,
- jamming of the conveyor with foreign bodies or damaged pads,
- Poor chain tension.

4.6.3.2.4 "Long ash removal stop" error

If ash removal is stopped for too long, the boiler stops and the same error appears on the touch screen.

4.6.3.2.4 Error "Absence of water in ash removal system"

The water level sensor allows you to adjust the water level and control the automatic filling. A second level sensor is provided to determine the low water level, in which case this error appears on the screen, but this does not lead to an immediate stop of the boiler. With the duration of the above error for some time (as determined by the manufacturer), the boiler will stop and the "Long ash removal stop" error will appear on the screen.

4.7 SMOKE EXHAUSTER

4.7.1 Operation Procedure

Under automatic control, the smoke exhauster removes the fumes and supports the continuous furnace draft. The draft is measured and controlled according to the set value (8 mmCE) by the exhaust fan speed via the frequency converter.

The smoke exhauster can operate in a manual mode: it is used to accelerate the furnace cooling to put down the fire and enable the ash cleaning during the annual manual cleaning.

4.7.2 Errors

4.7.2.1.1 Error "Smoke Exhauster Converter"

In the case of the error concerning the smoke exhauster converter, the boiler will stop and the error message will appear on the touch screen of the control Cabinet. To fix this error, refer to the passport of the Converter.

4.7.2.1.2 Error "High Temperature at the Smoke Exhauster Inlet"

The temperature of the flue gasses at the smoke exhauster outlet by theory shall be lower than the boiler outlet temperature. If the temperature at the exhaust outlet is over 130 ^{O}C and by more than 30 ^{O}C higher than the boiler outlet temperature, the boiler will stop and the corresponding error message will appear on the touch screen. Make sure there is no heat source between the boiler outlet and the smoke exhauster (burning or any other heat-exchanging reactions in the filter or ash tank).

4.9 ASH TANK

4.9.1 Operation Procedure

The conveyor located above the tank allows the usage of the entire area of the tank. The ash level should be regularly visually monitored.

For the ash removal, the ash container has a capacity of 0.25 (1.0) m3.

4.9.2 SAFETY

4.9.2.1 Safety Measures

During the conveyor operation, all the inspection doors must be closed.

4.9.2.2 Errors

4.9.2.2.1 Error "Lack of capacity for ash"

At the discharge of the ash removal conveyor, there is a sensor for the presence of ash. If there is no capacity on the touch screen, this message appears.
But this does not lead to an immediate stop of the boiler.
For some time (as determined by the manufacturer), the boiler stops and

An error "Too long stop of ash removal" appears on the screen.

Error "The current of the conveyor of ash from the furnace"
The electric current on the conveyor motor is measured. Over current or excess Voltage - this, most often, the result of blocking the conveyor. When the transporter stops, it will operate in the opposite direction for 5 seconds, then again move in the other direction. Such actions can be made three times. If after this excess voltage has not disappeared, the device stops and the error appears on the touch screen - Error "over current of the conveyor". In this case, it is necessary to stop the operation of the boiler, turn off the electrical equipment, then open the door of the conveyor to find the cause of the lock.

4.10 COMPRESSED AIR

Depending on the set-up, compressed air is supplied by the compressor or the external network. This compressed air must be dry and free of fats and greases to enable:

- cleaning level sensors.
- cleaning chimneys.

4.10.1 Error "Pressure Relay – Low Compressed Air Level"

Pressure relay allows defining the low pneumatic pressure level. In this case, the "Pressure Relay – Low Compressed Air Level" error message will appear and the boiler will stop. This problem must be promptly removed to avoid damage to other equipment, which is then not cleaned.

5. SETTINGS

Different settings buttons are designed for optimum boiler adjustments in the automatic mode, ensuring the safety of the power station and minimization of harmful emissions into the atmosphere has. These buttons are also designed to ensure the full operational autonomy.

5.1 Power Control and thermostatic stop for hot water generation

Power control (PID-type) enables a power mode wherein the boiler is steadily operating, providing the set temperature of output water. Therefore, this temperature is constantly measured and is compared with the predetermined temperature.

The energy, produced by the boiler, depends on the amount of fuel burnt: therefore, the changes of the power settings presuppose a change in the amount of fuel fed to the boiler. The amount of fuel fed to the boiler by means of a plunger is always the same: automatic control system defines the frequency needed to deliver the fuel to the boiler (during the first boiler start-up setting), this parameter is called the "Feeding Frequency".

Change of power settings requires changing other power station operating parameters:

- The amount of air required for combustion can be adjusted by changing the speed of different fans and changes in the opening of primary air valves. To calculate these parameters, the system performs linear interpolation of these parameters on the touch screen for the minimum and maximum power.
- Operating speed and time of the furnace bar movement varies with the given power (to provide the fuel burning out and moving down evenly). These settings can be performed on the control Cabinet touch screen.
- Ash removal speed rises with the power increase.

If the water feeding temperature exceeds the set temperature (5 ^{O}C), the boiler will stop (the thermostatic shutdown).

This means that:

- fuel feeding will stop,
-primary air, preheating and recirculation fans will stop
- furnace bar movement will be preserved, though with reduced speed,
- the smoke exhauster will continue operating to ensure the draft in the furnace.

The boiler will resume operation if the water feeding temperature falls and be no more than 2 ^{O}C above the set temperature.

5.2 Settings of the Furnace Draft

The pressure in the furnace is constantly measured: smoke exhauster speed is adjusted according to these measurements to maintain constant draft in the furnace; the given parameter is 8 mm CE.

5.3 Excess Air Settings

The amount of oxygen contained in the flue gasses is continuously measured at the exhaust outlet. The control is performed to maintain a predetermined amount of oxygen, usually 7%. This adjustment is made by opening the secondary air valves and depends on the fuel type.

5.4 Automatic Control Disruption

5.4.1 Replacing the Battery

If the battery of the automatic control device is weak, the display will show the corresponding window. It will need replacement within a week. To do it:

Switch off the automatic control device.

Open the battery compartment, located in the central part of the automatic control device.

Pull out the battery and immediately insert a new one: the replacement should take less than 5 minutes, otherwise data may be lost.

Close the compartment lid; turn on the power of the automatic control device.

5.4.2 I/O Problems

Warning: any operation associated with the dismantling of the board or the CPU must be carried out after the power supply disconnection.

The most common errors are as follows:

-If no input lights up, then there is no power supply of 24 VCC – check the 24 VCC fuse plugs, then the automatic control device board.

- If neither inputs nor outputs light up, then the 220 V fuse is switched off.

- If one output is no longer working, the board relay might be damaged by, for example, short circuits – check or replace the control element at the faulty output.

6 USER INTERFACE

a. Buttons on the Electric Control Cabinet

The master switch is located on the electric control cabinet side. It must be turned off during any electric works in the Cabinet.

There are different buttons on the electrical control cabinet:

- The button "Boiler Operation" can be in two positions: run/stop. This button indicates the overall status of the boiler. However, even in the stop position, some components go on working, for example, the smoke exhauster, which must work even many hours after the boiler shut down to vent fuel fumes, from the remaining fuel burning in the furnace.

- The plunger "Restart" button, which allows identifying the error, it is a necessary step before restarting the power station after an error.

- The plunger "Test Lamp" button, enabling the work of all light indicators, symbols on the touch screen and audible signal.

b. TOUCH SCREEN

Colour touch screen, which is located on the electric control cabinet, is the main tool to control the boiler operation. It allows you to visualize information, to choose the boiler operation method and adjust settings for optimal operation.

6.b.1 Information Visualization

6.b.1.1 Work Monitoring

There is a lot of information present on the screen schemes:

- Analogous readings: the fuel temperature, the fumes temperature, the coolant temperature, the pressure in the furnace and in the flue pipes, the pressure in the hydropower units, the amount of oxygen in the flue gas;

- specified values: required capacity, the rotation frequency of engines with frequency converters;

- an indication of different units status: work or stop (hydropower units, conveyors, cleaning systems), reversible speed, the position (opened/closed valves, forward/backward movement of the furnace bar...)

The majority of analogous readings, as well as the required boiler capacity, are continuously recorded in charts.

6.b.1.2 Troubleshooting

Different operational errors of the power station are visualized on the touch screen. Long-term statistics of these errors remains on the screen, specifying the date and time of their occurrence and fixing thereof. Errors, which did not lead to the boiler shutdown, are marked blue.

Each error has explanations on the screen and tips to fix them. Click the Errors entry in the statistics.

6.b.1.3 Maintenance

Many pages on the touch screen specify maintenance: they remind which operations shall be performed daily, monthly, yearly.

6.b.2 Selecting the functioning method "buttons"

The access code for the power station operators allows configuring different buttons. These pages contain buttons that control the boiler operation.

6.b.2.1 "Mini Flue Gases" Button: Run/Stop

This button allows choosing defining the too low temperature of flue gasses, that can happen at the fire extinction in the furnace. This control must be performed continuously, to avoid filling the furnace with fuel in the absence of combustion. At the first start-up of the boiler, this button shall be turned off until the time when the flue-gas temperature reaches the sufficient level.

6.b.2.2 "Power Control" Button: manual/auto, more/less

The power (capacity) of the boiler is automatically calculated at the "auto" setting.

Enabling the "manual" mode of the button, the control engineer can select the boiler operating power, using the buttons "more" "less".

This control method is undesirable, but for the start-up phase and necessary testing.

6.b.2.3 "Fuel Type" Button: Fuel/Fuel 2/Fuel 3

The boiler settings depend on the fuel characteristics (moisture content, density, granulometry). The manufacturer offers the possibility to use 3 types of fuel, the "Fuel Type" button allows selection of the optimal settings for each type of fuel.

6.b.2.4 "Manual/Auto" Button

These buttons allow choosing manual or automatic control of the following units:

- Furnace bar,
- Ash removal,
- Smoke exhaust.

Different settings correspond to these two control modes.

6.b.2.5 "Run/Stop" Button

Buttons that allow controlling the boiler operation or shut-down are as follows:

- "Fuel feeding to the Furnace": the whole fuel delivery chain from the storage to the furnace.
- "Fuel Delivery ": in most power stations – the conveyor.
- "Removing Fuel from the Storage": a system of extracting fuel from the storage ("Push Floor")
- "Boiler Cleaning": cleaning system for the heat exchanger tubes. This system works in cycles.

6.b.3 Settings

There are two types of setting access: for the boiler operating engineer and for the manufacturer personnel (this is mainly for the purpose of SAFETY). Therefore, different setting modes require different passwords.

6.b.4 Replacing the Touch Screen Battery

After getting the message about the touch screen low battery, it shall be replaced. in order to do this:

1. Switch off the screen power.
2. Open the battery compartment: it is located behind the screen.
3. Pull out the battery and immediately insert a new one: the replacement should not take more than 5 minutes, otherwise data may be lost.
4. Close the lid and turn on the power on the screen.

7 POWER STATION OPERATION

7.1 Boiler Cold Start-up

1. Fill the boiler with water, the quality of which corresponds to the requirements of the manufacturer.
2. Check the hydraulics

Follow the instructions to the hydraulic systems.

Valves shall be opened in the way to prevent high pressure or wrong temperature in the boiler, which means:

- Access to the water network.
- Water circulation in the boiler.
- The automatic air purging tap is opened.
- All emptying and cleaning taps shall be closed.
- The exhaust duct tap is closed.
- All taps for measuring gauges are opened.

3. Make sure there are no leaks.
4. Check the operational integrity of all boiler components.
5. Check the settings of safety devices.
6. Blow all air pipes and chimneys.
7. Determine fuel characteristics (moisture content, density, granulometry) to apply the appropriate settings.
8. Make sure all screen buttons are in "Work" or "Auto" position: this means that all the components of the station are ready for operation. The "Mini Flue Gases" button can be turned to "Stop": this will allow avoiding an error message caused by to too low flue gas temperature. After heating the boiler activate this button to "Work".
9. Make sure that the "Ash Removal" button is turned to "Auto".
10. Turn on the "Boiler Operation" button to "work". The power station will start up: a certain amount of fuel is needed to get into the furnace.
11. As soon as the fuel covers the first rows of the furnace bar (approximately 40 cm in length), the "Boiler Operation" button shall be turned to "Stop": the entire power station will stop.
12. Ignite the fuel in the furnace through the furnace door. Close the door.
13. Turn the "Fuel Feeding to the Furnace" button on the touch screen to "Stop".
14. Turn the "Boiler Operation" button to "Operate": the power station will start working; the air blown by the fan will help to ignite the fuel.
15. Turn the "Power Control" button to "Manual" and manually set the power at 30%. Activate the "Fuel Supply" button.
16. The temperature shall rise gradually, to ensure that the combustion has spread throughout the furnace and to protect the equipment. To make this possible:

- Follow the instructions of the heat exchanger manufacturer.
- Slowly increase the boiler capacity (30%, 40%, 50%, 65%, 80%), each time making sure that burning is not waning and there is no extra fuel in the furnace. This will prevent the concrete from cracking.

Note: to cure the concrete during the first boiler start-up, observe the boiler heating scheme, provided by the manufacturer of the concrete.

17. On the manual increase of the boiler power, turn the "Power Control" button to "Auto".

18. If during the boiler start-up it is disconnected from the heating system, the connection shall be performed at the same pressure at the boiler outlet and the system.

19. Make sure that all buttons have been turned to "Work" or "Auto" as well as the "Mini Flue Gases" button.

Now the power station is in normal operation mode: make sure that the boiler operation settings correspond to the given type of fuel. To do this, make sure that the fuel is evenly burned in the furnace, and only ash remains at the end of the furnace bar.

7.2 **HOT START-UP OF THE HOT-WATER BOILER**

This start-up procedure is applied provided that the following conditions are met:

- The boiler is filled with water which temperature is at least 5 ^{O}C below the ordinary temperature of the return water;
- The furnace is still hot (temperature over 200 ^{O}C);
- The unburned fuel remains in the furnace.

1. Make sure that the boiler is filled with water.
2. Check hydraulics.

Since the boiler manufacturer is not a supplier of heating systems, it is necessary to follow instructions of the heating system developers for proper connection of the boiler to the network.

The valves shall be opened after checking the pressure and temperature in the boiler, and the following requirements shall also be fulfilled:

- There is access to the water network.
- There is stable water circulation in the boiler.
- All emptying and cleaning taps shall be closed.
- All the taps emptying and cleaning should be closed.
- The exhaust duct tap is closed
- All taps for measuring gauges are opened.

1. Make sure there are no leaks.
2. Check the operational integrity of all boiler components.
3. Check the settings of safety devices.
4. Determine fuel characteristics (moisture content, density, granulometry) to apply the appropriate settings.
5. Make sure all screen buttons are in "Work" or "Auto" position: this means that all the components of the station are ready for operation. The "Mini Flue Gases" button can be turned to "Stop": this will allow avoiding an error message caused by to too low flue gas temperature. After heating the boiler activate this button to "Work".
6. Make sure that the "Ash Removal" button is turned to "Auto".
7. Turn on the "Boiler Operation" button to "work". The power station will start up: a certain amount of fuel is needed to get into the furnace.

As soon as the fuel covers the first rows of the furnace bar (approximately 40 cm in length), the "Boiler Operation" button shall be turned to "Stop": the entire power station will stop.

8. Look through the inspection window to make sure that the combustion in the furnace has resumed.
9. Turn the "Power Control" button to "Manual" and manually set the power at 30%. Activate the "Fuel Supply" button.

12. Slowly increase the boiler capacity (30%, 40%, 50%, 65%, 80%), each time making sure that burning is not waning and there is no extra fuel in the furnace. This will prevent the concrete from cracking.

Note: to cure the concrete during the first boiler start-up, observe the boiler heating scheme, provided by the manufacturer of the concrete.

10. On the manual increase of the boiler power, turn the "Power Control" button to "Auto".

11. If during the boiler start-up it is disconnected from the heating system, the connection shall be performed at the same pressure at the boiler outlet and the system.

12. If the boiler is isolated from the rest of the network, in order to start it, open the valves connecting the boiler to the network only after checking the temperature and the pressure (they must be the same).

13. Make sure that all buttons have been turned to "Work" or "Auto" as well as the "Mini Flue Gases" button.

Now the power station is in normal operation mode: make sure that the boiler operation settings correspond to the given type of fuel. To do this, make sure that the fuel is evenly burned in the furnace, and only ash remains at the end of the furnace bar.

7.3 SHUTDOWN OF THE HOT-WATER BOILER

In order to safely stop the boiler, remove all the fuel from the feed chain from the storage to the furnace. For this purpose:

1. Stop the fuel withdrawal from the storage: turn the "Fuel Withdrawal" button to "Stop".

2. Wait for a few fuel feeding sequences for emptying the conveyor (not less than 3 sequences). Then turn the "Fuel Feeding" button to "Stop".

3. Wait till the end of combustion in the furnace, until the flame out.

4. Turn the "Boiler Fuel" button to "Stop". The smoke exhauster will continue operating until the temperature in the flue pipes decreases.

5. Do not stop the water circulation pumps in the boiler until the temperature in the furnace decreases.

7.4 KEEPING THE BOILER IN WORKING CONDITION

After stopping the boiler, the power station can be with or without water. For specific requirements refer to the technical descriptions of the heat exchanger manufacturer.

7.5 ASH TANK REPLACEMENT

When ash tank is full, it must be replaced:

1. Stop the ash removal screw conveyor (with the corresponding button on the touch screen).
2. Turn off the ash screw conveyor engine switch.
3. Turn off the ash tank screw conveyor.
4. Pull out the tank.
5. Put the new tank in its place by attaching hose pipe over the tank.
6. Make sure that the inspection door is closed.
7. Turn on the screw conveyor.
8. Turn on the ash screw conveyor engine.
9. Reactivate the ash removal system with the corresponding button on the screen. If the ash removal has been off for a long period of time, the corresponding error will appear on the screen and the boiler will stop.

7.6 TROUBLESHOOTING

A number of continuously measured parameters are provided to guarantee the normal operation of the boiler. If some unit is malfunctioning, a corresponding error message will appear on the touch screen. Most of the errors lead to the boiler shut down, to avoid danger or equipment damage.

Troubleshooting steps at the boiler shutdown:

1. Consult the screen to see which error has occurred.
2. Refer to the technical description in order to understand the nature of the error and the ways to fix it, or find the corresponding instructions on the screen.
4. Following the security requirements, fix the error.
5. Restart the boiler by pressing the red "Reset" button. If the boiler was stopped for over 10 minutes, refer to the description of hot or cold start-up.

8 ERRORS AND BOILER SETTINGS

ERRORS :

OPERATION: FUEL WITHDRAWAL, TRANSPORTATION, AND FEEDING

Fuel Withdrawal from the Storage				
PLACE	***NOTIFICATION***	***AUDIO SIGNAL***	***ERROR TIME***	***Warning***
CIO 160.00	Switch off the fuel storage hydraulic power unit			X
CIO 160.01	Shut-down of the fuel withdrawal engines	X		
CIO 160.03	ARU of the fuel withdrawal			X
CIO 160.04	Lengthy fuel withdrawal pause	X		
Fuel Transportation				
PLACE	***NOTIFICATION***	***AUDIO SIGNAL***	***ERROR TIME***	***Warning***
CIO 161.00	Fuel conveyor switch			X
CIO 161.02	Fuel conveyor rotation	X		
CIO 161.03	Fuel conveyor over current	X		
CIO 161.05	Lengthy fuel conveyor stop	X		
CIO 161.06	Fuel pressing on the conveyor	X		
Fuel Feeding				
PLACE	***NOTIFICATION***	***AUDIO SIGNAL***	***ERROR TIME***	***Warning***
CIO 162.00	No oil in the furnace hydraulic power unit	X		
CIO 162.01	Shut-down of the furnace engine	X		
CIO 162.04	End of plunger movement	X		
CIO 162.06	End of shutter movement	X		
CIO 162.07	Overheating in the plunger chute	X		
CIO 162.08	No fuel in the fuel feed chute			X
CIO 162.09	Fuel pressing in the feed chute			X
CIO 162.10	No fuel in the fuel feed chute	X		
CIO 162.11	Fuel pressing in the feed chute	X		
CIO 162.12	Lengthy fuel feeding pause	X		

Furnace

Furnace Bar				
PLACE	NOTIFICATION	AUDIO SIGNAL	ERROR TIME	Warning
CIO 163.02	End of the forward bar movement			X
CIO 163.03	End of the forward bar movement	X		
CIO 163.04	End of the backward bar movement			X
CIO 163.05	End of the backward bar movement	X		
CIO 164.15	Excessive Furnace Bar Stop	X		

SAFETY				
PLACE	NOTIFICATION	AUDIO SIGNAL	ERROR TIME	Warning
CIO 165.12	Low primary air pressure	X		
CIO 165.13	Low secondary air pressure 1	X		
CIO 165.14	Low secondary air pressure 2	X		
CIO 166.00	Pressure excess in the furnace	X		
CIO 166.01	Low pressure in the furnace			X
CIO 166.02	Furnace or heat exchanger door is open	X		
CIO 166.06	Low temperature in the furnace			X
CIO 166.07	High temperature in the furnace	X		
CIO 166.08	High temperature in the furnace bottom	X		
CIO 166.09	High temperature in the furnace middle level	X		
CIO 166.10	High temperature in the furnace top	X		

Ash removal

Wet and dry ash removal				
PLACE	NOTIFICATION	AUDIO SIGNAL	ERROR TIME	Warning
CIO 167.00	Shut-down of the ash removal engine		variable	
CIO 167.02	Ash removal speed		variable	
CIO 167.03	Ash conveyor over current		variable	
CIO 167.13	Ash conveyor switch		variable	
CIO 167.15	Lengthy ash removal pause	X		
CIO 170.15	Lengthy dry ash removal pause	X		

Flue gas cleaning

Cleaning/filtering the flue gasses				
PLACE	NOTIFICATION	AUDIO SIGNAL	ERROR TIME	Warning
CIO 172.01	Mini flue gasses	X		
CIO 172.02	Excessive stop of mini flue gasses check	X		
CIO 172.03	Boiler outlet high temperature		72hours	
CIO 172.04	Smoke exhaust high temperature	X		
CIO 172.05	High oxygen level			X
CIO 172.06	Low oxygen level			X
CIO 172.07	Smoke exhaust high temperature	X		
CIO 172.09	Boiler outlet high temperature	X		

Water network

Network safety				
PLACE	***NOTIFICATION***	***AUDIO SIGNAL***	***ERROR TIME***	***Warning***
CIO 176.00	Water overheating in the boiler	X		
CIO 176.01	No water pressure in the boiler	X		
CIO 176.02	Low inlet water temperature	X		
CIO 176.03	Low outlet water temperature	X		
CIO 176.04	Low outlet water temperature			X
CIO 176.05	Low power input			X
CIO 176.06	Low power input, boiler shutdown	X		
CIO 176.07	Low Power, Restarting Prohibited for 5 hours	X		
CIO 176.08	No water passage in the heat exchanger	X		
Other				
PLACE	***NOTIFICATION***	***AUDIO SIGNAL***	***ERROR TIME***	***Warning***
CIO 177.02	Low compressed air pressure		72hours	
CIO 177.03	Boiler ARU	X		

Adjustments:

PID Controller Instructions

DM	Description	scale	adjustment	acces
	P, I, D adjustment: for every adjustment			
PID of the furnace draft, touch screen PID controller				
D4001	P : proportional range PID of the furnace draft	1-270F(hex)	150	WEISS
D4002	I : integral range PID of the furnace draft	1-1FFF(hex)	150	WEISS
D4003	D: derivative range PID of the furnace draft	0-1FFF(hex)	0	WEISS
capacity PID, touch screen PID controller				
D4051	P: proportional range capacity PID	1-270F(hex)	4D2	WEISS
D4052	I: integral range capacity PID	1-1FFF(hex)	200	WEISS
D4053	D: derivative range capacity PID	0-1FFF(hex)	0	WEISS
Oxygen PID, touch screen PID controller				
D4101	P: proportional range Oxygen PID	1-270F(hex)	600	WEISS
D4102	I: integral range Oxygen PID	1-1FFF(hex)	300	WEISS
D4103	D: derivative range Oxygen PID	0-1FFF(hex)	0	WEISS

Combustion air

DM	Description	scale	Floating reference	acces
	Standardizing of the combustion air fuel 1			
	Air flaps, fuel 1, page 1			
D3016	Instruction for opening a secondary air1 mini flap1 at minimum capacity	0/100%		
D3018	Instruction for opening a secondary air1 mini flap1 at maximum capacity	0/100%		
D3017	Instruction for opening a secondary air1 maxi flap1 at minimum capacity	0/100%		
D3019	Instruction for opening a secondary air1 mini flap2 at minimum capacity	0/100%		
D3021	Instruction for opening a secondary air1 mini flap2 at maximum capacity	0/100%		
D3020	Instruction for opening a secondary air1 maxi flap2	0/100%		
D3022	Instruction for opening a secondary air1 mini flap3 at minimum capacity	0/100%		
D3024	Instruction for opening a secondary air1 mini flap3 at maximum capacity	0/100%		
D3023	Instruction for opening a secondary air1 maxi flap3	0/100%		
D3025	Instruction for opening a secondary air 2 mini flap1 at minimum capacity	0/100%		
D3027	Instruction for opening a secondary air 2 mini flap1 at maximum capacity	0/100%		
D3026	Instruction for opening a secondary air 2 maxi flap1	0/100%		
D3028	Instruction for opening a secondary air 2 mini flap2 at minimum capacity	0/100%		
D3030	Instruction for opening a secondary air 2 mini flap2 at maximum capacity	0/100%		
D3029	Instruction for opening a secondary air 2 mini flap2	0/100%		
D3031	Instruction for opening a secondary air 2 mini flap3 at minimum capacity	0/100%		
D3033	Instruction for opening a secondary air 2 mini flap3 at maximum capacity	0/100%		
D3032	Instruction for opening a secondary air 2 mini flap3	0/100%		
	Air Speed, fuel 1 page 2			
D3042	Instruction for primary airspeed at minimum capacity	0/100%		
D3043	Instruction for primary airspeed at maximum capacity	0/100%		
D3052	Instruction for secondary air speed 1 at minimum capacity	0/100%		
D3053	Instruction for secondary air speed 1 at maximum capacity	0/100%		
D3054	Instruction for secondary air speed 2 at minimum capacity	0/100%		
D3055	Instruction for secondary air speed 2 at maximum capacity	0/100%		

DM	Description	scale	Standardizing	access
	Standardizing of the combustion air fuel 2			
	Air Flaps, fuel 2 page 1			
D3216	Instruction for opening a secondary air1 mini flap1 at minimum capacity	0/100%		
D3218	Instruction for opening a secondary air1 mini flap1 at maximum capacity	0/100%		
D3217	Instruction for opening a secondary air1 maxi flap1 at minimum capacity	0/100%		
D3219	Instruction for opening a secondary air1 mini flap2 at minimum capacity	0/100%		
D3221	Instruction for opening a secondary air1 mini flap2 at maximum capacity	0/100%		
D3220	Instruction for opening a secondary air1 maxi flap2	0/100%		
D3222	Instruction for opening a secondary air1 mini flap3 at minimum capacity	0/100%		
D3224	Instruction for opening a secondary air1 mini flap3 at maximum capacity	0/100%		
D3223	Instruction for opening a secondary air1 maxi flap3	0/100%		
D3225	Instruction for opening a secondary air 2 mini flap1 at minimum capacity	0/100%		
D3227	Instruction for opening a secondary air 2 mini flap1 at maximum capacity	0/100%		
D3226	Instruction for opening secondary air 2 maxi flap1	0/100%		
D3228	Instruction for opening a secondary air 2 mini flap2 at minimum capacity	0/100%		
D3230	Instruction for opening a secondary air 2 mini flap2 at maximum capacity	0/100%		
D3229	Instruction for opening a secondary air 2 mini flap2	0/100%		
D3231	Instruction for opening a secondary air 2 mini flap 3 at minimum capacity	0/100%		
D3233	Instruction for opening a secondary air 2 mini flap 3 at maximum capacity	0/100%		
D3232	Instruction for opening a secondary air 2 mini flap 3	0/100%		
	Air Speed, fuel 2 page 2			
D3242	Instruction for primary airspeed at minimum capacity	0/100%		
D3243	Instruction for primary airspeed at maximum capacity	0/100%		
D3252	Instruction for secondary air speed 1 at minimum capacity	0/100%		
D3253	Instruction for secondary air speed 1 at maximum capacity i	0/100%		
D3254	Instruction for secondary air speed 2 at minimum capacity	0/100%		
D3255	Instruction for secondary air speed 2 at maximum capacity	0/100%		
DM	**Description**	scale	Standardizing	acces

Standardizing of the combustion air
fuel 3

	Air Flaps, fuel 3 page 1			
D3116	Instruction for opening a secondary air1 mini flap1 at minimum capacity	0/100%		
D3118	Instruction for opening a secondary air1 mini flap1 at maximum capacity	0/100%		
D3117	Instruction for opening a secondary air1 maxi flap1 at minimum capacity	0/100%		
D3119	Instruction for opening a secondary air1 mini flap2 at minimum capacity	0/100%		
D3121	Instruction for opening a secondary air1 mini flap2 at maximum capacity	0/100%		
D3120	Instruction for opening a secondary air1 maxi flap2	0/100%		
D3122	Instruction for opening a secondary air1 mini flap3 at minimum capacity	0/100%		
D3124	Instruction for opening a secondary air1 mini flap3 at maximum capacity	0/100%		
D3123	Instruction for opening a secondary air1 maxi flap3	0/100%		
D3125	Instruction for opening a secondary air 2 mini flap1 at minimum capacity	0/100%		
D3127	Instruction for opening a secondary air 2 mini flap1 at maximum capacity	0/100%		
D3126	Instruction for opening secondary air 2 maxi flap1	0/100%		
D3128	Instruction for opening a secondary air 2 mini flap2 at minimum capacity	0/100%		
D3130	Instruction for opening a secondary air 2 mini flap2 at maximum capacity	0/100%		
D3129	Instruction for opening a secondary air 2 mini flap2	0/100%		
D3131	Instruction for opening a secondary air 2 mini flap 3 at minimum capacity	0/100%		
D3133	Instruction for opening a secondary air 2 mini flap 3 at maximum capacity	0/100%		
D3132	Instruction for opening a secondary air 2 mini flap 3	0/100%		
	Air Speed, fuel 3 page 2			
D3142	Instruction for primary airspeed at minimum capacity	0/100%		
D3143	Instruction for primary airspeed at maximum capacity	0/100%		
D3152	Instruction for secondary air speed 1 at minimum capacity	0/100%		
D3153	Instruction for secondary air speed 1 at maximum capacity	0/100%		
D3154	Instruction for secondary air speed 2 at minimum capacity	0/100%		
D3155	Instruction for secondary air speed 2 at maximum capacity	0/100%		

Furnace

DM	Description	scale	adjustment	Access
	Adjustment: Safety instructions, furnace			
	Furnace, screen, page 1			
D180	Draft norm	0/100 mm		
D181	Inlet water temperature	0/250 °C		
D182	Oxygen amount	0/20 %		
D183	Temperature of mini flue gases	0/120 °C		WEISS
D184	Low draft, boiler start-up	0/100 mm		
	Operating delay, screen, page 2			
D830	Error delay mini flue gasses	MIN		WEISS
D853	Error delay High Pressure in the Furnace	1/10 Sec		WEISS
D833	Delay of the Smoke Exhauster Disabled	MIN		
	Off screen			
D980	Error delay of the Low Temperature in the Furnace	MIN	20	WEISS
D982	Error delay of the Furnace Temperature, pre-heating bottom, middle level, top	MIN	20	WEISS
D984	Error delay of Low and High Oxygen	MIN	20	WEISS
D986	Error delay of Low Inlet Water Temperature	MIN	30	WEISS
D933	Maximum stop for mini flue gasses check	MIN	60	WEISS
	SAFETY			

DM	Description	scale	adjustment	access
	adjustment: safety instructions			
	SAFETY *page 1*			
D680	Furnace overheating temperature	0/1200 °C		WEISS
D681	Low temperature in the furnace	0/1200 °C		WEISS
D682	Low inlet water temperature	0/250 °C		WEISS
D683	Low outlet water temperature	0/250 °C		WEISS
D994	Delta fuel 1 low capacity	°C		WEISS
D996	Delta fuel 1 low capacity	°C		WEISS
D998	Delta fuel 1 low capacity	°C		WEISS
	Off Screen Safety			
D907	Maximum error delay End of filter movement	1/10°s	3000	WEISS
	Manual control			

DM	Description	scale	adjustment	access
	Adjustment: Manual control instructions			
	Manual speed page 1			
D170	Manual settings of the smoke exhauster speed	0/100%		
D171	Manual settings ash conveyor speed from the furnace	0/100%		
D174	Manual settings of the ash conveyor speed	0/100%		
D172	Manual settings of the furnace bar speed	0/100%		
	furnace bar			

DM	Description	scale	Standardizing	access
	Adjustment: furnace instructions			
	Furnace bar page 1			
D2500	Delay of the furnace bar movement 20 % fuel 1	1/10°Sec		
D2501	Delay of the furnace bar movement 40 % fuel 1	1/10°Sec		
D2502	Delay of the furnace bar movement 60 % fuel 1	1/10°Sec		
D2503	Delay of the furnace bar movement80 % fuel 1	1/10°Sec		
D2504	Delay of the furnace bar movement 100 % fuel 1	1/10°Sec		
D2505	Time of the furnace bar movement, fuel 1	1/10°Sec		
D2506	Delay of the furnace bar movement 20 % fuel 2	1/10°Sec		
D2507	Delay of the furnace bar movement 40 % fuel 2	1/10°Sec		
D2508	Delay of the furnace bar movement 60 % fuel 2	1/10°Sec		
D2509	Delay of the furnace bar movement 80 % fuel 2	1/10°Sec		
D2510	Delay of the furnace bar movement 100 % fuel 2	1/10°Sec		
D2511	Time of the furnace bar movement, fuel 2	1/10°Sec		
D2512	Delay of the furnace bar movement 20 % fuel 3	1/10°Sec		
D2513	Delay of the furnace bar movement 40 % fuel 3	1/10°Sec		
D2514	Delay of the furnace bar movement 60 % fuel 3	1/10°Sec		
D2515	Delay of the furnace bar movement 80 % fuel 3	1/10°Sec		
D2516	Delay of the furnace bar movement 100 % fuel 3	1/10°Sec		
D2517	Time of the furnace bar movement, fuel 3	1/10°Sec		
D834	Delay of the audio signal notifying about the lengthy furnace bar movement stop	MIN		WEISS
D831	Delay of the recurring furnace bar movement after the thermal stop	MIN		WEISS
	Furnace bar off screen			
D950	Delay of the furnace bar movement at auto mode	1/10°Sec	200	WEISS
D810	Delay of the furnace bar movement at the thermal stop	1/10°Sec	30	WEISS

Fuel feeding

DM	Description	scale	Standardizing	access
	Adjustment: Instructions of fuel withdrawal from the storage, shutter, and feeding			
	Fuel feeding page 1			
D880	Fuel 1 feed frequency at minimum capacity	Sec		
D881	Fuel 1 feed frequency at maximum capacity	Sec		
D882	Fuel 2 feed frequency at minimum capacity	Sec		
D883	Fuel 2 feed frequency at maximum capacity	Sec		
D884	Fuel 3 feed frequency at minimum capacity	Sec		
D885	Fuel 3 feed frequency at maximum capacity	Sec		
D987	Fuel feed delay after the thermal stop	Min		
	Fuel feeding off screen			
D803	Maximum time of back feed travel	1/10 Sec	600	WEISS
D804	Maximum time of forth feed travel	1/10 Sec	800	WEISS
D805	Maximum time of feed opening	1/10 Sec	600	WEISS
D806	Maximum time of feed closing	1/10 Sec	600	WEISS
D807	Maximum number of feed closing before an error	/	3	WEISS
D808	Maximum number of feed opening before an error	/	3	WEISS
D886	Time of forth feed travel	1/10 Sec	600	WEISS
D887	Forth feed travel delay	1/10 Sec	50	WEISS
D931	Maximum stop time of the fuel conveyor	Min	30	WEISS
D932	Maximum stop time of fuel feeding	Min	30	WEISS

	Shutter page 2			
D800	Fuel demand delay	1/10 Sec		WEISS
D801	Fuel stop delay	1/10 Sec		WEISS
D811	Maximum loading time	1/10 Sec		WEISS
	Shutter off screen			
D809	Maximum shutter opening time	1/10 Sec	600	WEISS
D835	No fuel	/	9000	WEISS
D836	Excessive fuel	/	9000	WEISS
	Fuel withdrawal from the storage page 3			
D846	Stop delay of the fuel withdrawal from the storage	1/10 Sec		
D820	Travel delay of the fuel withdrawal from the storage	1/10 Sec		
D821	Travel time of the fuel withdrawal from the storage forth cylinder 1,(3, 5) and back cylinder2,(4,6)	1/10 Sec		
D822	Travel time of the fuel withdrawal from the storage back cylinder1,(3, 5) and forth cylinder 2,(4,6)	1/10 Sec		
D430	Audio signal duration	1/10 Sec		
D431	Number of hydroelectric power units for the fuel storage	/		WEISS
D177	Conveyor speed	0/100%		WEISS
	Fuel withdrawal from the storage of screen			
D813	Error delay of the 180 bars pressure switch, fuel storage	1/10 Sec	2400	WEISS
D930	Maximum pause of the fuel withdrawal from the storage	Min	30	WEISS
	FUEL CHARACTERISTICS TOUCHSCREEN BUTTONS 3			
D690	FUEL 1 MOISTURE CONTENT	0/100%		
D691	FUEL 2 MOISTURE CONTENT	0/100%		
D692	FUEL 3 MOISTURE CONTENT	0/100%		
D693	Fuel 1 density	Kg/m³		
D694	Fuel 2 density	Kg/m³		
D695	Fuel 3 density	Kg/m³		

Ash removal

DM	Description	scale	adjustment	access
	Adjustment: Ash removal			
	ASH REMOVAL PAGE 1			
D852	Travel time of the ash removal from the furnace	1/10 Sec		
D851	Pause duration of the ash removal from the furnace	Min		
D175	Speed of the ash removal conveyor from the furnace at minimum capacity	0/100%		
D176	Speed of the ash removal conveyor from the furnace at maximum capacity	0/100%		
D850	Maximum pause of the ash removal from the furnace	Min		WEISS
D856	Travel time of the dry ash removal	1/10 Sec		
D854	Pause duration of the dry ash removal at minimum capacity	Sec		
D855	Pause duration of the dry ash removal at maximum capacity	Sec		
D849	Maximum pause of the dry ash removal	Min		WEISS
	ASH REMOVAL OFF SCREEN			
D891	Screw conveyor of the wet ash removal tank stop delay	1/10 Sec	150	WEISS
D892	Ash conveyor stop delay	1/10 Sec	50	WEISS
	CLEANING PAGE 2			
D904	Boiler cleaning delay	Min		WEISS
D905	Operating period of the boiler solenoid valves	1/10 Sec		WEISS
D906	2 boiler solenoid valves delay	1/10 Sec		WEISS

9. OPERATION AND MAINTENANCE

9.1 FUEL STORAGE

Daily	
	Visually monitor the amount of fuel in the fuel storage for the timely supply.
Daily when delivered	
	At each delivery check the conformity with the fuel characteristics (moisture content, density, granulometry).

9.2 "PUSH FLOOR"

Daily	
	Observe the operation of the sweepers through the conveyor inspection door, to ensure proper operation and conveyor filling.
	Make sure there are no leaks in the hydraulic system (hydraulic station, cylinders).
	Visually check the hydraulic station oil level and temperature.
Weekly	
	Check the pressure on the hydraulic power unit gauge.
Monthly	
	Using the pressure gauge of the hydraulic power unit, check for binding of the hydraulic power unit filter. If necessary, clean the filter.
Stop the boiler (for 24-48 h) 2 times during the heating season, cool it down, switch off, and lock it.	
	Clear the fuel storage completely; check the condition of the sweepers.
Each year, at the end of the heating season, stop the power station cool it down, switch off, and lock it.	
	Clear the fuel storage completely; check the condition of the sweepers and tighten the beams.

	Hydroelectric power unit: **- drain and change the oil after cleaning the tank,**
	- replace the metal mesh and the filter.
	Control cylinders, pipes, and hoses and replace the pipe junctions, if necessary.
	Grease shafts and the cylinder spherical joints

9.3 FUEL CONVEYOR

	Daily
	Check and adjust the oil level in the chain greasing tanks.
	Weekly
	Check the water pressure in the automatic irrigation facet (AVTA).
	Monthly
	Free the conveyor, to check the consoles condition and their fixation on the chain. If damaged, replace the details (to replace them, stop the boiler).
	Check the chain tension.
	Grease the bearings and check their fixation.
	Check the oil level in the gearbox motor.
	Check the automatic irrigation facet (AVTA) performance. : - clean the water filter - submerge the probe in a tank of water with the temperature of 45°C, make sure that the valve opens at this temperature. (if necessary adjust it).
	Stop the boiler (for 24-48 h) 2 times during the heating season, cool it down, switch off, and lock it.
	Check the gear box motor condition.
	Each year, at the end of the heating season, stop the power station cool it down, switch off, and lock it.
	Drain and replace oil in gear box motor.

9.4 HOPPER (CHUTE) AND PLUNGER

	Daily
	Make sure that the chute is filled correctly, that is the fuel level is sufficient. Otherwise, the problem can be at the top of the fuel feeding chain.
	Make sure there are no leaks in the hydraulic system (hydraulic station, cylinder, pipes, hoses).
	Visually check the oil level and temperature in the hydraulic power unit.

	Weekly
	Clean the fuel level sensors in the chute above the plunger (4 sensors). Note: Do NOT enter the chute!
	Monthly
	Using the pressure gauge of the hydraulic power unit, check for binding of the hydraul power unit filter. If necessary, clean the filter (for this stop the boiler).
	Check the automatic irrigation facet (AVTA) performance. : - clean the water filter - submerge the probe in a tank of water with the temperature of 45°C, make sure that the valve opens at this temperature. (if necessary adjust it).
	Stop the boiler (for 24-48 h) 2 times during the heating season, cool it down, switch off, and lock it.
	Check the plunger condition.
	Check the shutter condition.
	Grease the shutter bearings
	hydraulic power unit: **- drain and change the oil after cleaning the tank,**
	- replace the metal mesh and the filter.
	Control cylinders, pipes, and hoses and replace the pipe junctions, if necessary.
	Grease shafts and the cylinder spherical joints.
	Check the condition of the shutter and plunger sensors.
	Check the condition of the level sensors

9.5 FURNACE

	DAILY
	Check visually through the inspection window that the fuel in the furnace burns and is evenly distributed.
	Check the tightness of the furnace access door.
	Make sure there are no leaks in the hydraulic system.
	Check the oil level and temperature in the hydraulic power unit.
	Verify the following with the graphic charts on the screen: - the proper furnace draft (approximately – 8 mmCE) – otherwise, refer to the description of the smoke exhauster operation; - the amount of oxygen at the smoke exhauster outlet is correct (5 – 11 %, according to th instruction) – otherwise, refer to the description of the furnace operation; - there is the proper temperature in the furnace (depends on power).
	Weekly
	Check the furnace bar operation cycle (movement forward, the end of the movement, the movement backward, the end of the movement, movement forward...).
	Check the operation of fans and air flaps.

	Make sure that ash residues do not interfere with primary air: to do so, inspect the inputs and clean them if necessary.
	Through the inspection, window makes sure that the furnace bar beams are in their place and are not raised.
	For boilers without wet ash removal: free space under the furnace bar from ash. This work depends on the amount of ash from different fuel types and combustion control.
	Clean the pressure sensor in the furnace from dust. Use an air gun on previous pressure sensor removal from the furnace.
Monthly	
	Check for binding of the hydraulic power unit filter. If necessary, clean the filter (to do so, stop the boiler).
	Air Flaps, - grease the shafts, - rotate them to avoid their blocking with the ash between the furnace bar
	Check the condition of all sealed joints (doors, pipes, fans)
	Grease the fan bearings.
	Check the status of the oxygen measuring probe at the smoke exhauster outlet: remove, purge it. Caution: be careful when working with the probe – it is hot.
	Check the standardizing of the furnace draft measuring probe: when removing it from the furnace, the rate of the draft shall be 0mmCE; otherwise, you need to standardize it again (see the description of the probe).
Stop the boiler (for 24-48 h) 2 times during the heating season, cool it down, switch off, and lock it.	
	When the power station is cold: - clean the combustion chamber walls, - remove the ash accumulated above the top panel.
	When there is no fuel or ash in the furnace, carefully check: - the furnace bar, - top panels - heat-resistant concrete, - side runner slides for the furnace bar, - furnace bar frame bearings, - air flaps
Each year, at the end of the heating season, stop the power station cool it down, switch off, and lock it.	
	Thoroughly clean the furnace, remove the ash from the furnace, the combustion chamber and the primary air chambers.
	Make sure the heat-resistant concrete is in good condition. In the case of its damage, contact the manufacturer for repair. Note: after repair, follow the recommendations on concrete treatment.
	Check the condition of the cross bars, pulling them out for cleaning and replace the damaged ones.
	Check : - furnace bar frame, - furnace bar frame bearings, - frame movement stops.

	Clean: - air inlets, -air flaps,, - fans.
	Activate the flaps to verify their operation.
	Grease the cylinder hinges and axes.
	Hydraulic power unit:
	- drain and replace the oil - replace the metal mesh and the filter.
	Control cylinders, pipes, and hoses and replace the pipe junctions.

9.6 HEAT EXCHANGER

	DAILY
	Check the flow and backwater temperature on the screen
	Check for any leaks in the taps.
	Check the operation of the pressure support group and circulation pumps.
	Weekly
	Check the water quality according to the requirements of the manufacturer.
	Open draining taps for a few seconds to avoid accumulation of sediment.
	Monthly
	Open the inspection door and remove the ash.
	Check the security system of the boiler safety valves, etc.
	Check the tightness of valves, flanges, doors.
	Stop the boiler (for 24-48 h) 2 times during the heating season, cool it down, switch off, and lock it.
	Check the plating of the heat exchanger and the inspection door.
	Open the air chamber door in order to: - remove the ashes, - perform a manual clean-up.
	Each year, at the end of the heating season, stop the power station cool it down, switch off, and locl it.
	When the boiler is cold isolate it from the mains.
	Drain and inspect the boiler. Flush the boiler if there is sediment or other deposits.
	Check the sealing of the doors and replace them if necessary.
	Check the heat exchanger and the heated surface for rust.

9.8 WET ASH REMOVAL AND ASH CONVEYOR

Daily	
	Check the water level in the ash conveyor, it is maintained automatically. Otherwise, make sure: - the water supply is open, - water level sensors are non-faulty, - the solenoid valve is not defective.
	Make sure there are no leaks.
	Visually check the operation of the conveyor.
Weekly	
	Open draining taps for a few seconds to avoid accumulation of sediment.
Monthly	
	Monitor the condition of the consoles and their fixation. If damaged, replace them (to do so, stop the boiler).
	Check the chain tension.
	Grease the bearings and check the shaft fixation.
	Check the oil level in the gearbox motor.
	Clean the water inlet mesh.
Stop the boiler (for 24-48 h) 2 times during the heating season, cool it down, switch off, and lock it.	
	When the boiler is cold and empty check the following: - chains, - consoles - guides, - pinions, - gear box motor.
	Fix possible leaks.
Each year, at the end of the heating season, stop the power station cool it down, switch off, and lock it.	
	Drain and change the oil in the gear box motor.
	When the boiler is cold and empty check the following: - chains, - consoles - guides, - pinions, - gear box motor.
	Fix possible leaks.
	Paint refreshment.

9.10 ASH TANK

DAILY	
	Check the level and quality of ash in the tank and empty it regularly
Monthly	
	Grease the bearings and check the shaft fixations.
	Check the oil level in the gearbox motor.

	Check the condition of the screw wings
Biennially	
	Change the oil in the screw conveyor gearbox.

9.11 POWER STATION

Monthly	
	Check the intensity of the radiation absorption by the engines.
	Clean the electrical Cabinet ventilation filters.
Stop the boiler (for 24-48 h) 2 times during the heating season, cool it down, switch off, and lock it.	
	Check the electrical units clamps and connections.
	Check the security system.
Every 6 months at normal boiler operation	
	Setting control of alarm, security, switches. The sensor control must be performed at normal boiler operation by triggering errors that shall be detected by these sensors.
Each year, at the end of the heating season, stop the power station cool it down, switch off, and lock it.	
	Clean the electrical Cabinet inside.
	Check the electrical units clamps and connections.
	Control of all electrical equipment, probes, sensors.
Every 3 years	
	Changing the battery of the automatic control unit and the touch screen.

9.12 GAS BURNER FOR THE IED OPERATION FOR THE DIRECTIVE 2000/76/EC/.

For the Maintenance of the gas burner, please refer to the document "GULLIVER_RG5DF.pdf" – Section 7

10. Information on Reclamation.

10.1 Complaints to the manufacturer shall be presented in cases when the boiler low-quality manufacturing leads to its breakage or loss of the basic characteristics specified in the instruction. A document specifying the nature and reasons for the breakage or loss of key characteristics, conditions and operation modes with the required short description, sketches, etc. shall be attached to the reclamation.

10.2 Boiler operation failures as a result of a violation of storage, transportation, installation requirements, improper operation, poor service and/or untrained staff cannot be the basis for the complaint.

10.3 The reclamation materials shall have an authorized signature and approved by the boiler-operating company management.

The reclamation record is performed in table No. 6.

Reclamation Record.

Table. 6

Document No. (certificate of complaint)	Complaint details	Sent to	Response to the complaint	Authorized signature

Annual Performance Records.

Months	Final Annual Performance Record		
	20 .		
	Number of hours	Total in service	Signature
January February March April May June July August September October November December January February March April May June July August September October November December January February March April May June July August September October November December January February March April May June July August September October November December			

Records of Operational Malfunctioning.

Date and time of the product (its component parts) failure. The operation mode. The nature of the load	Nature (the manifestation) of a failure,	The cause of the failure, number of hours of work of the failed component	Fault handling measures are taken for, reclamation notation	Position, surname, and signature of the person responsible for fault handling	Note

Maintenance Record.

Date	Maintenance	Comments about the technical condition	Position, name, and signature of the responsible person

11 WARRANTY

REFER TO THE TERMS OF THE CONTRACT.