Introduction:

Auxiliary boiler is used to provide the plant with saturated steam. It is used whenever there is a water demand and no or low electricity demand. Also it is used when there is maintenance on the waste heat recovery boiler. The main components are the FD fan (force draught fan), burners, upper and lower drums, downcomers and risers (evaporator), the economizer and the feedwater.

The feedwater comes first to the economizer then into the upper drum. From the upper drum it is naturally cycled to the lower drum through the downcomers and then back to the upper drum as steam through the risers and then to the steam header. The FD fan provides the boiler with combustion air and the airflow to heat the risers and the downcomers to change the water coming from the upper drum into steam. After that the airflow goes out through the boiler’s stack to the atmosphere; at this time the wasted heat in the airflow is used to pre-heat the feedwater coming to the upper drum through the economizer. There are quality sensors to measure the amount of O₂ and CO₂.

The Process:

This auxiliary boiler can use three kinds of fuel: NG, DFO and HFO. Due to its high price the DFO had never been used in auxiliary boilers. The NG is recommended due to its low price and environmental issues. The HFO is our second choice. To ignite the burners Propane or NG is used.

The NG comes to the boiler with a pressure of 5 bar then it goes to a reducing stage which uses a self regulating valve. After that it is separated to three levels and each level controls two burners. Like the WHRB after the reducing station there is a flow control and measurement station were it controls the flow of the NG depending on the load required.

The HFO comes with a pressure of 16-18 bar with a temperature of 130°C. It is divided to the three levels for controlling and it goes to the burners with a pressure of 10 bar (depending on load). Due to its high viscosity and density it has to be heated up and then atomizing steam is used to make the HFO as small particles in the burner to have much more efficiency. If steam is not available atomizing air is used only for level one.
Controlling The HFO Flow:

Two controlling are there for measuring and controlling the flow of HFO going to the burners. One is before the burner and the other one is on the returning line. In the start up and shut down procedures the return line is in control which opens fully to shut of the burner and closes to start up the burner. This is done to prevent high pressure on the pipe and HFO pump. The controlling before the burner changes depending on the boiler load.

Tripping The Boiler:

Water level in the upper drum should not exceed 350 mm and not decreasing below the minimum. FD fan should be working all the time. Airflow should not be low. Fuel pressure should not be below than minimum and higher than the max (e.g. in HFO it should be not less than 1.4 bar). HFO temperature should be between 90°C and 150°C other than that trip will occur.

Auxiliary Boiler combustion Control:

Steam load is controlled by the combustion in the boiler burners. The combustion in the burners is controlled by the fuel flow. The fuel flow is limited by the airflow. Whenever there is a steam load demand change; the signal will go to a min. selector compared with the airflow to the combustion; the minimum value will be subtracted from the fuel flow to control the fuel flow. Also the airflow is controlled by a max. Selector between the steam demand and fuel flow. The steam load signal is connected to the minimum boiler load with a max. selector. The minimum load is 28%.

Upper Drum Level Control:

The level in the drum is controlled by a 100% control valve that have a feedback from the drum level and the difference between the feedwater inlet and the steam outlet. The inlet flow and outlet flow signals are corrected with some values to insure accurate quantity. After that both signal are connected to a subtractor and then an added along with set point and level difference. In addition the level change will be corrected by the pressure change in order to minimize the flow fluctuation. Just before the finale control the feedback is connected to a minimum selector along with the steam minimum load of 28%.
Flame detector (see next page):

UV/IR: it is the ultraviolet and infrared detector, which consists of an ultraviolet phototube that responds to radiation in (185 to 260) nanometer region when the radiation strikes the cathode. This will cause a movement of electron (Cathode (-ve) to the Anod (+ve)) is going faster when the flame radiation is more. The detector will give alarm only if it detects (UV and IR) together.

Flame monitoring (IRIS 3000):

Including flame-monitoring module, which consist (flame monitoring bar, K101 relay). The type of flame scanner used for monitoring is (IRIS 3000), which consists of two-color sensor (silicon photoelectric (Si). Lead sulphide (pds)) both are responding to the radiation wavelength.

The radiation is an energy, which can spread out and travel, and it varies as per the temperature (the hotter the object is the high energy the radiation can be) for example, the Ultraviolet energy is more than infrared.
The radiation intensity will be represent on the flame-monitoring bar. If the intensity of the flame was more than 45%, flame on signal will be generated and transfeere to the protection panel.
Flame detector
IRIS 3000

Aperture
flame radiation
entrance

Silicon photo-electric
(PBS)

Lead Sulphide
(SI)
Ionization Igniter:

The process of converting into ions and the state of being ionized is called ionization, in this way the flame is monitored. Moreover, the ionisation effect and the rectifying effect of the flame produce a d.c current which flows from the ignitor tube via the flame to the ionisation electrode and then through the connecting rods back to the amplifier and thus serves as a flame signal.