Cairo University
Faculty of Engineering
Mech. Power Department _____

ACC Virtual Labs
Automatic Control Circuits &Virtual Labs
for Mechanical Power Systems
معمل التحكم الأتوماتيكى و المعامل الإفتراضية لأنظمة القوى الميكانيكية

دبلوم تطبيقات التحكم الأوتوماتيكى فى نظم القوى الميكانيكية

MEP 563 Virtual Labs -   Report # 1b- on Running Virtual Lab for a Water-Tube Boiler

Part II (After Running the Virtual Lab):

Submit a separate report to describe at least one method to control each of the following processes in order to safely and efficiently run a water-tube boiler (you have to specify types of used sensors, control elements & any used schematics):
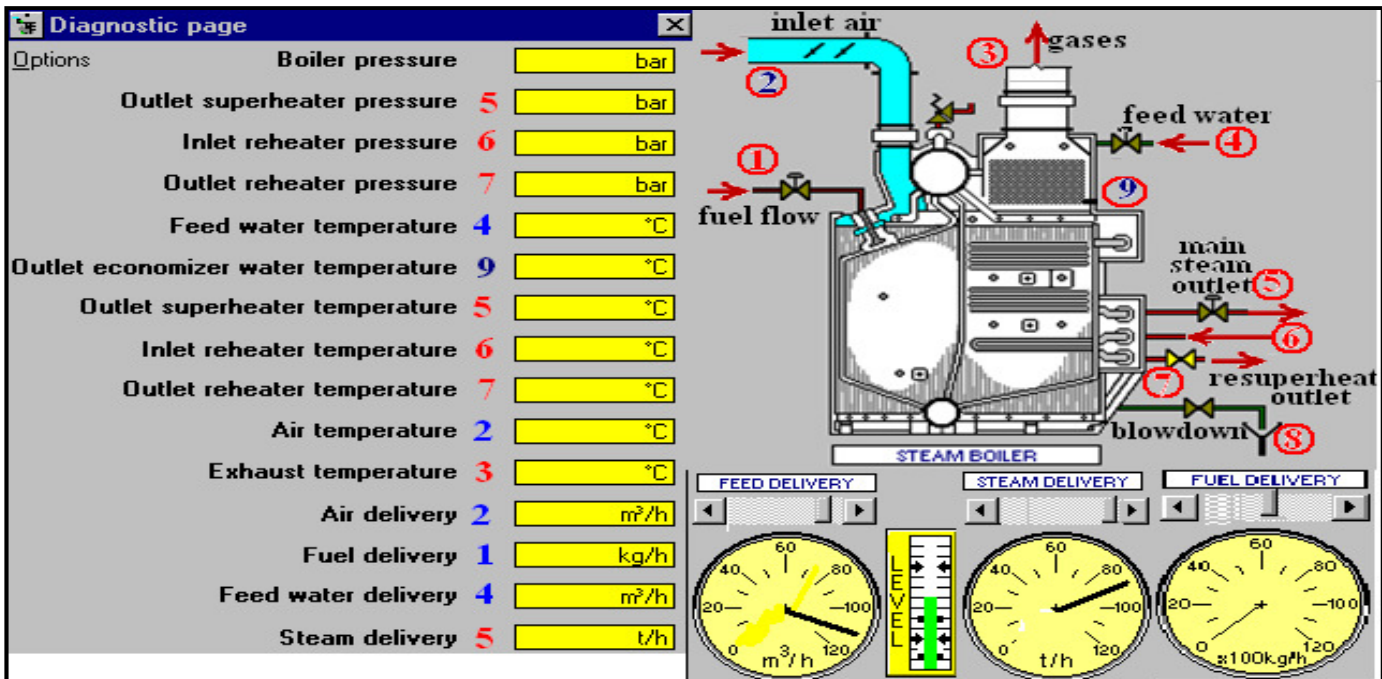
1-Adjusting the optimum air-to-fuel ratio for maximum combustion efficiency at different boiler loads.

2- On/off control for dual fuel burner types including liquid fuel atomization and gaseous fuel combustion.

3-Liquid fuel supply, handling, storage, and treatment for different type of fuels and different operation conditions.

4- Adjusting a safe and constant water level in the boiler superior drum for different boiler loads or operation conditions.

5- Control the maximum allowable steam pressure in the water tube boiler.

6- Control the super heated steam temperature at the super heater outlet point.

7- Control the amount of super heated steam flow rate at the super heater outlet point.

8- Control the flow rate and temperature of the feed water supply into the economizer section.

9- Control the amount of dissolved gasses in the feed water through the de-aerator tank

10- Control the blow-down process of the boiler both manually and automatically.

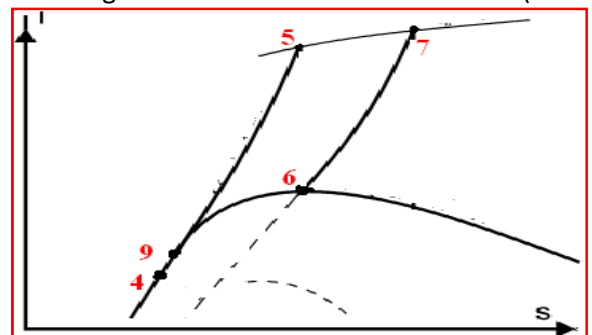### *Report and all calculations Requirements*

Exercise # 1:

The Re-superheater is activated (the re-superheater outlet valve is opened):

1- Run the Boiler **for 4-5 minutes** in the **automatic** mode (at a pressure of about 95 bar) and maximum main steam outlet (steam delivery control is at maximum position).

2- Print the diagnostic page for above run. Use values on that page to fill-in the following sheet:
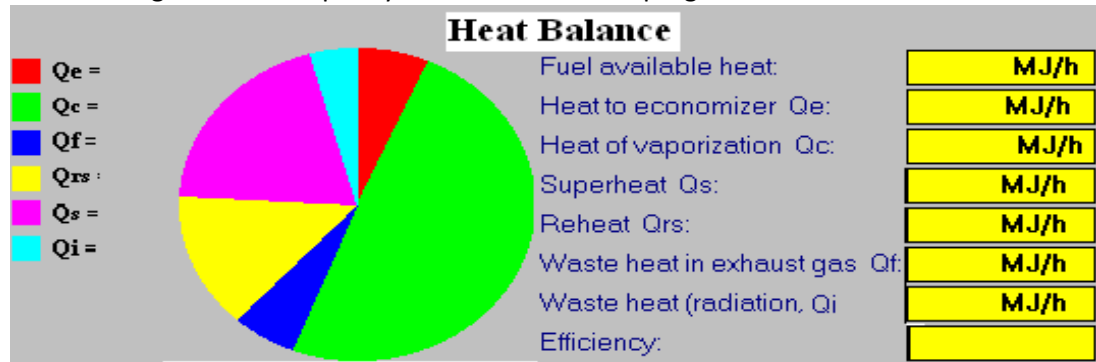

3- Calculate all the following magnitudes/values which are necessary for doing the heat balance calculations (make a comparison table between your calculations and the program calculations):

- Quantity of available heat in the fuel Qd;
- Quantity of heat used in the economizer Qe;
- Quantity of heat used in the generator tubes Qg;
- Quantity of heat used in the superheater Qs;
- Quantity of heat used in the re-superheater Qrs;
- Quantity of heat lost in the funnel for fumes Qf;
- Quantity of heat lost for radiation and unburned Qi.

4- Sketch the boiler heating processes on the i-s (Mollier chart for steam).
5- Calculate the Heat Balance Bi-diagram and compare your calculations and program calculations

Heat Balance

🟥 Qe =	Fuel available heat:	MJ/h
🟩 Qc =	Heat to economizer Qe:	MJ/h
🟦 Qf =	Heat of vaporization Qc:	MJ/h
🟨 Qrs ⁝	Superheat Qs:	MJ/h
🟪 Qs =	Reheat Qrs:	MJ/h
🔷 Qi =	Waste heat in exhaust gas Qf:	MJ/h
	Waste heat (radiation, Qi	MJ/h
	Efficiency:	

Exercise # 2:

<u>The Re-superheater is not activated (the re-superheater outlet valve is closed):</u>
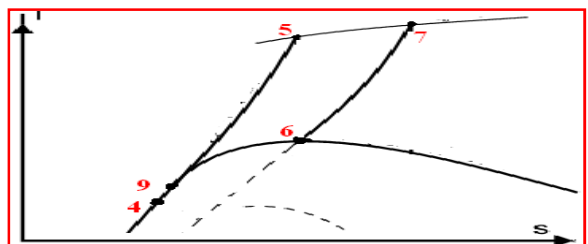
1-Run the Boiler **for 4-5 minutes** in the **automatic** mode (at a pressure of about 95 bar) and maximum main steam outlet (steam delivery control is at maximum position).

2- Print the diagnostic page for above run. Use values on that page to fill-in the following sheet:

3- Calculate all the following magnitudes/values which are necessary for doing the heat balance calculations (make a comparison table between your calculations and the program calculations):

■ Quantity of available heat in the fuel Qd;
■ Quantity of heat used in the economizer Qe;
■ Quantity of heat used in the generator tubes Qg;
■ Quantity of heat used in the superheater Qs;
■ Quantity of heat used in the re-superheater Qrs;
■ Quantity of heat lost in the funnel for fumes Qf;
■ Quantity of heat lost for radiation and unburned Qi.

4- Sketch the boiler heating processes on the i-s (Mollier chart for steam).
5- Calculate the Heat Balance Bi-diagram and compare your calculations and program calculations

Heat Balance

🟥 Qe =	Fuel available heat:	MJ/h
🟩 Qc =	Heat to economizer Qe:	MJ/h
🟦 Qf =	Heat of vaporization Qc:	MJ/h
🟨 Qrs ⁝	Superheat Qs:	MJ/h
🟪 Qs =	Reheat Qrs:	MJ/h
🔷 Qi =	Waste heat in exhaust gas Qf:	MJ/h
	Waste heat (radiation, Qi	MJ/h
	Efficiency:	