Cairo University
Faculty of Engineering
Mech. Power Department

دبلوم تطبيقات التحكم الأوتوماتيكى
فى نظم القوى الميكانيكية

MEP 599 Diploma Design Project- Fall Term 2016

Control of Burner Management System (BMS) using PLC Technology

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Abstract:

This project discusses the proposed changes to the currently implemented electromechanical devices which are running in cooperation with a distributed control system (DCS). A PLC (programmable logic controller) has been lately recommended to be added to a burner management system (BMS) to increase the fired heater's efficiency and to provide better services like purging, emergency shutdown, shutdown, flame detection and better fuel consumption. Additionally, the BMS will increase the furnace's reliability and will decrease unplanned shutdown times. Furthermore, With a simple ladder diagram (LAD) and a sequential function chart(SFC) , it's obviously easier to track the status of inputs and outputs instead of having the operator to be physically close to the burner for ignition and flame monitoring. Moreover, diagnostics are better facilitated while operating the PLC than with the current working system.

The burner under investigation runs with fuel gas only and the pilots require ignition via utilizing an ignition transformer and ionization rod. In fact, there are many procedures which were followed to complete this project and they are as listed below:

- **We completely provided the details of the furnace datasheets along with its current operating conditions.**
- **We calculated the present furnace's efficiency to indicate the impedance of providing operation neither at full capacity nor at optimum operating conditions due to the lack of a healthy control system.**
- **We created an SFC chart and a ladder diagram representing the operation of the BMS which includes purging, starting pilot and fuel gas burner.**
- **We used the i-TRILOGI simulation software to attempt running the ladder diagram and observe the status of inputs and outputs.**

Project Scope:

•To clearly understand the basics of control and instrumentation for a fired chemical heater and the burner management system (BMS) which are necessary for any engineer/ technician working close to systems that encompass controlling burners such as fired heaters, such as in refinery, or boilers, if he/she works in a steam generation unit.

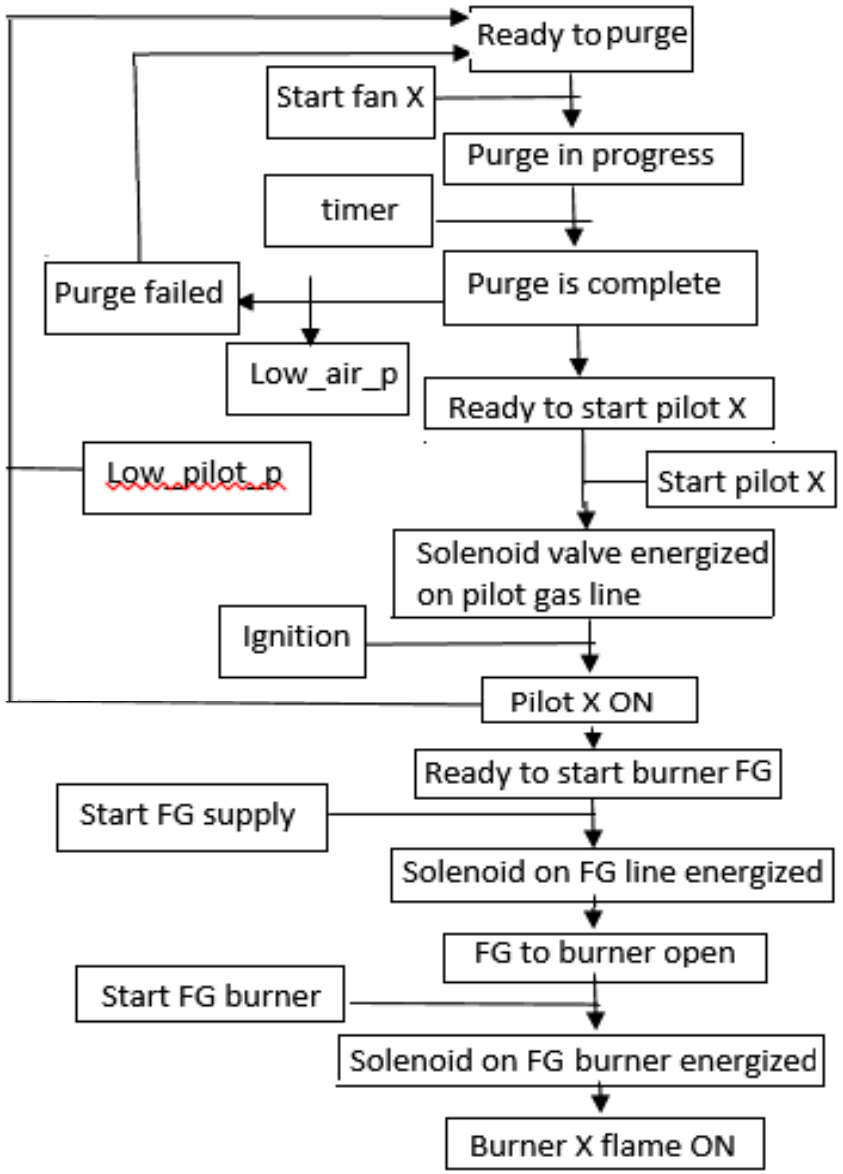
•To carefully study the current efficiency of the fired heater and to discuss the positive impact on the chemical fired heater including start-ups, shutdowns, emergency shutdowns, flame monitoring systems& alarms that form intrinsic parts of any burner management system nowadays.

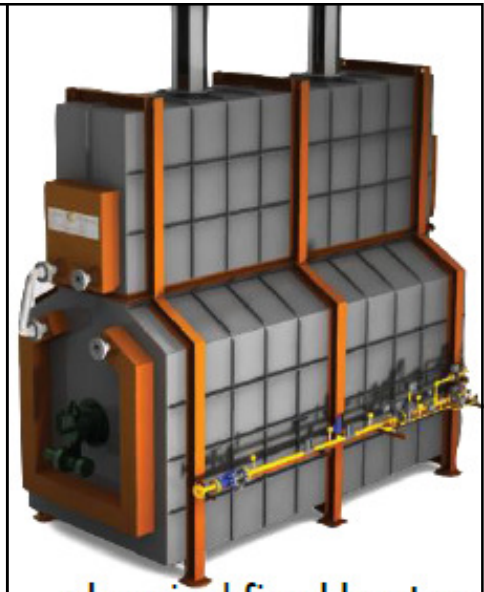
•Aiding the understanding of international standards for safe operations in a chemical fired heater.

•Attempting to present the steps of starting the BMS panel in a clear not very technical and yet very operation staff friendly in a language that is obvious and understandable.

•Providing a sequential function chart (SFC) for the procedures of running the BMS panel and successfully starting a burner by following ladder diagram (LAD) sequences.

Sequential function chart (SFC):



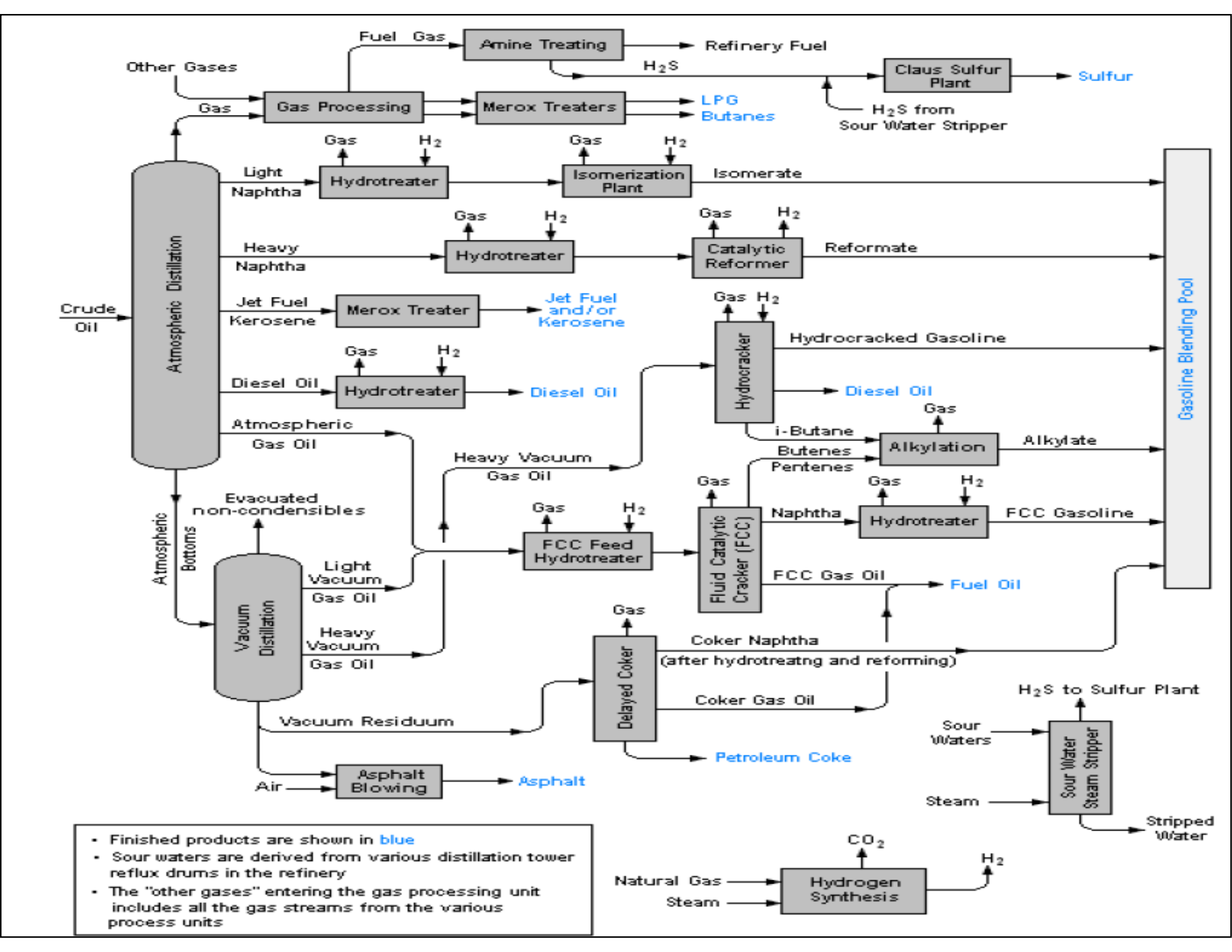


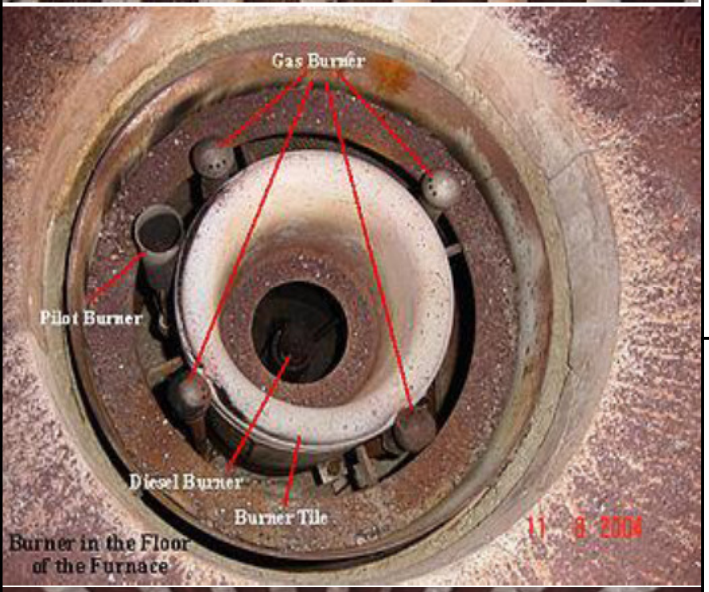
chemical fired heater

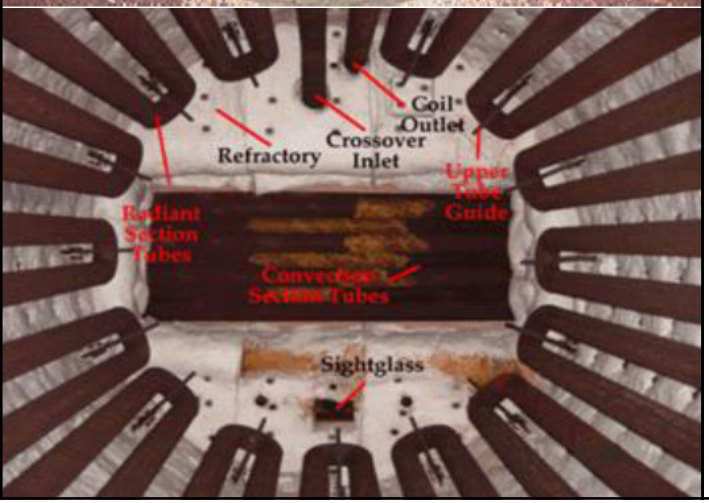
A plc panel

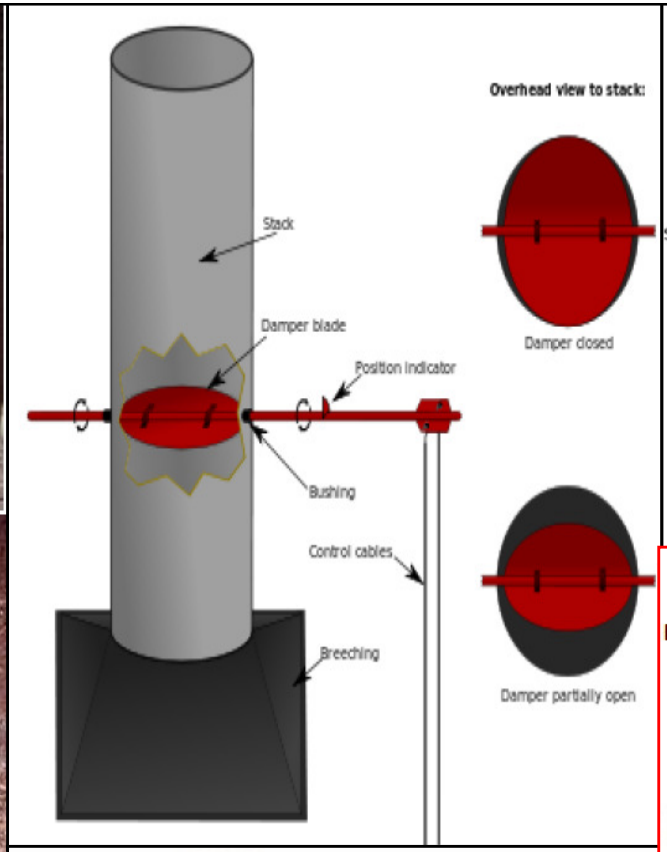
Conclusion:

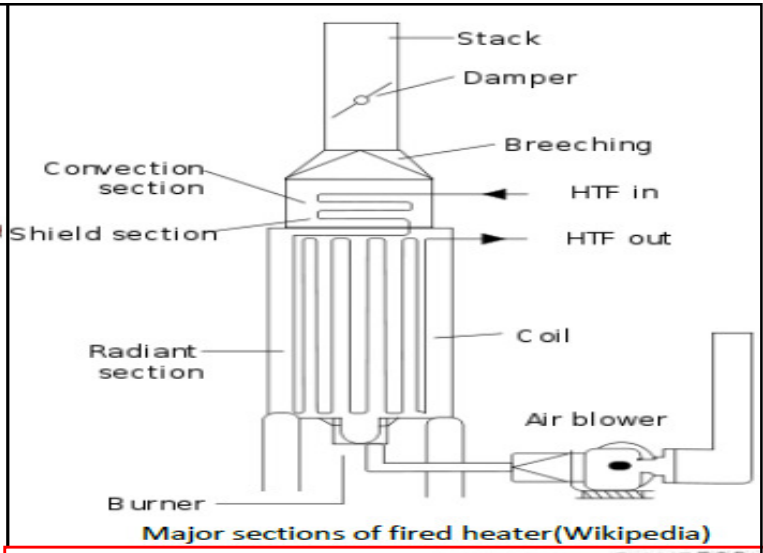
It is evident that implementing a BMS will greatly increase the levels of safety and will reduce unplanned shutdown periods to a substantial extent and therefore increase operation hours and fired heater's life-time. Moreover, the flame detection feature obviously reduces the risks involved in burners ignition and it will also decrease flame impingement chances which mean a worry-free environment to both engineers and technicians. However, carefully understanding the mechanisms of running the BMS and adapting to the new proposed changes could take some time and that's what the operation manual actually tries to simplify to reach anyone standing near the panel. Additionally, if the BMS is correctly linked to a distributed control system, which controls the A/F ratio, fuel consumption and previous fired heater efficiency will be optimised.


Fuel Gas
Amine Treating
Refinery Fuel
Other Gases
H_2S
Claus Sulfur Plant
Sulfur
Gas
Gas Processing
Merox Treaters
LPG
Butanes
H_2S from Sour Water Stripper
Gas
H_2
Light Naphtha
Hydrotreater
Isomerization Plant
Isomerate
Heavy Naphtha
Catalytic Reformer
Reformate
Crude Oil
Atmospheric Distillation
Jet Fuel Kerosene
Merox Treater
Jet Fuel and/or Kerosene
Diesel Oil
Diesel Oil
Atmospheric Gas Oil
Hydrocracker
Hydrocracked Gasoline
Heavy Vacuum Gas Oil
i-Butane
Butenes
Pentenes
Alkylation
Alkylate
Gasoline Blending Pool
Evacuated non-condensibles
Atmospheric Bottoms
Vacuum Distillation
Light Vacuum Gas Oil
Heavy Vacuum Gas Oil
FCC Feed Hydrotreater
Fluid Catalytic Cracker (FCC)
Naphtha
FCC Gasoline
FCC Gas Oil
Fuel Oil
Coker Naphtha
(after hydrotreatng and reforming)
Delayed Coker
Coker Gas Oil
Vacuum Residuum
Petroleum Coke
H_2S to Sulfur Plant
Sour Waters
Sour Water Steam Stripper
Steam
Stripped Water
Air
Asphalt Blowing
Asphalt
CO_2
Natural Gas
Steam
Hydrogen Synthesis
H_2
• Finished products are shown in blue
• Sour waters are derived from various distillation tower reflux drums in the refinery
• The "other gases" entering the gas processing unit includes all the gas streams from the various process units

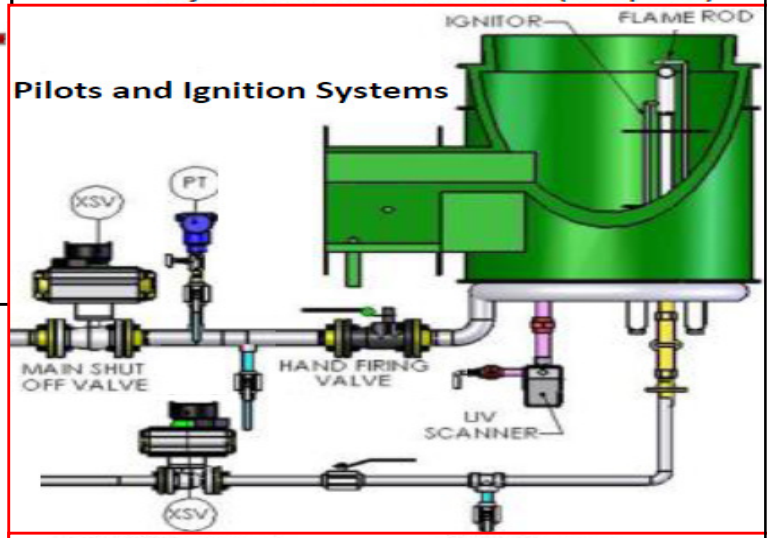


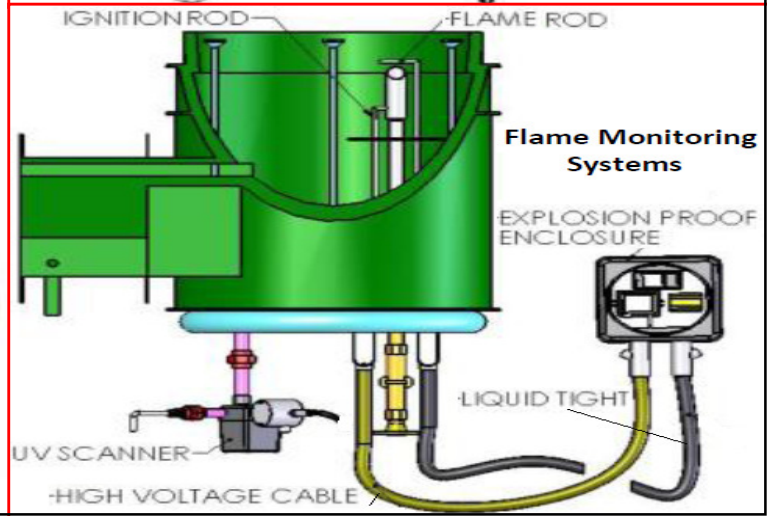




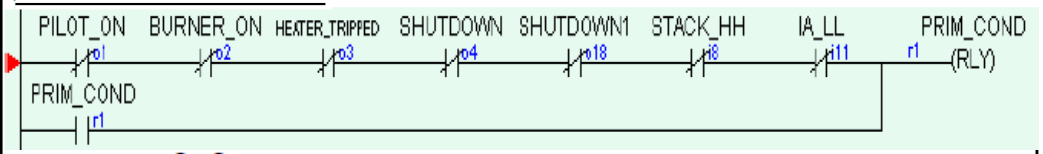


Major sections of fired heater(Wikipedia)

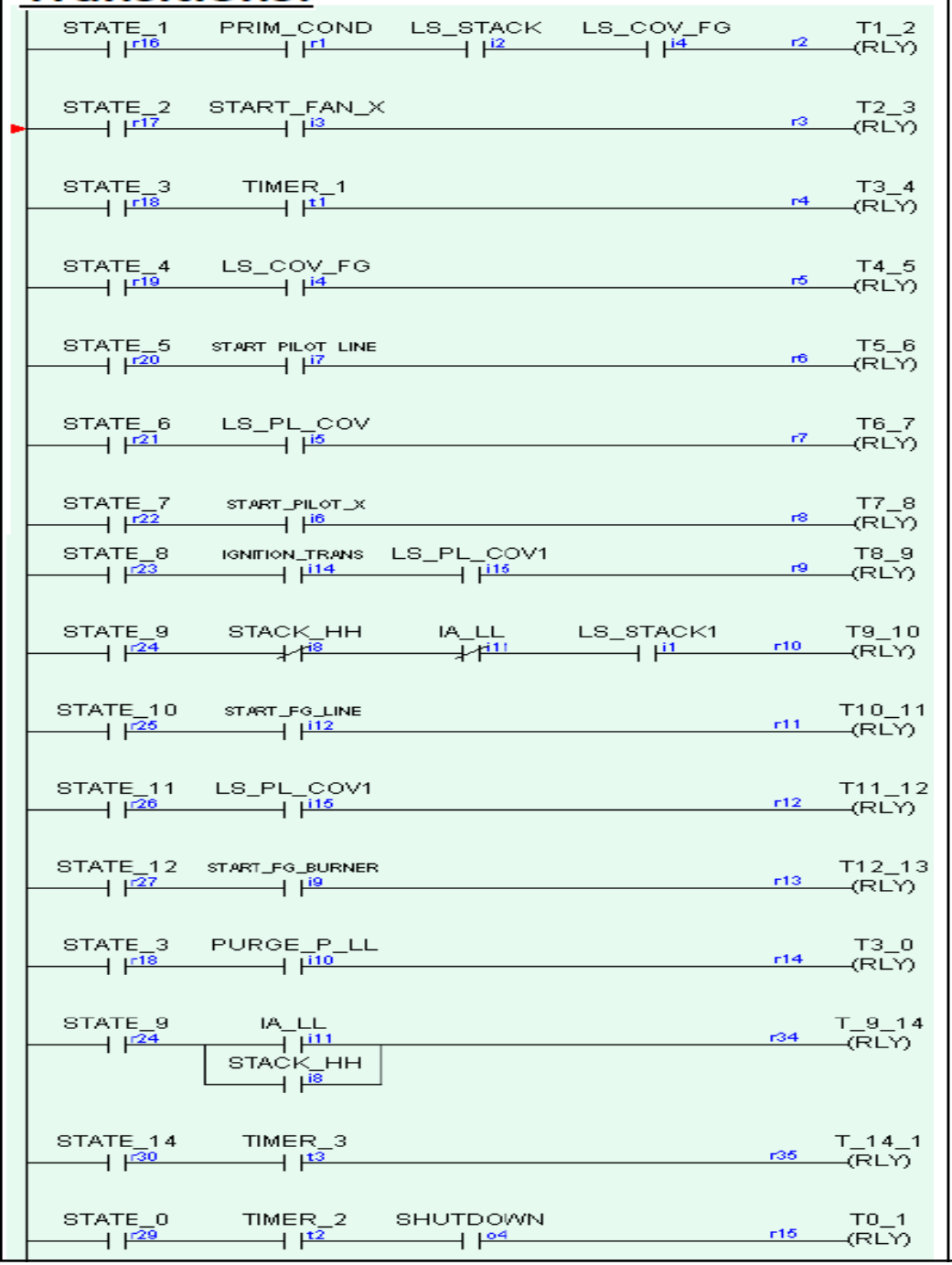




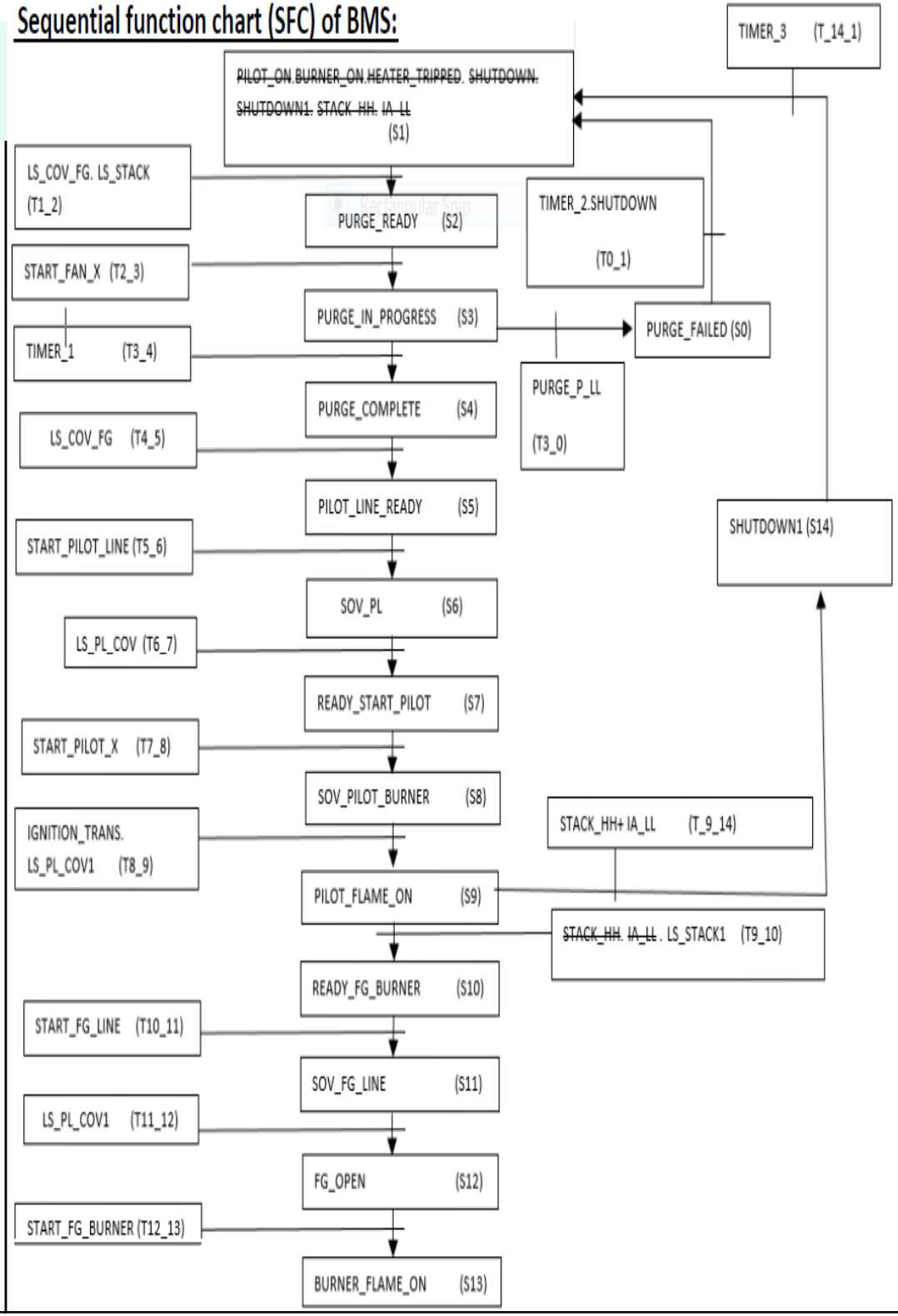
Initial conditions:



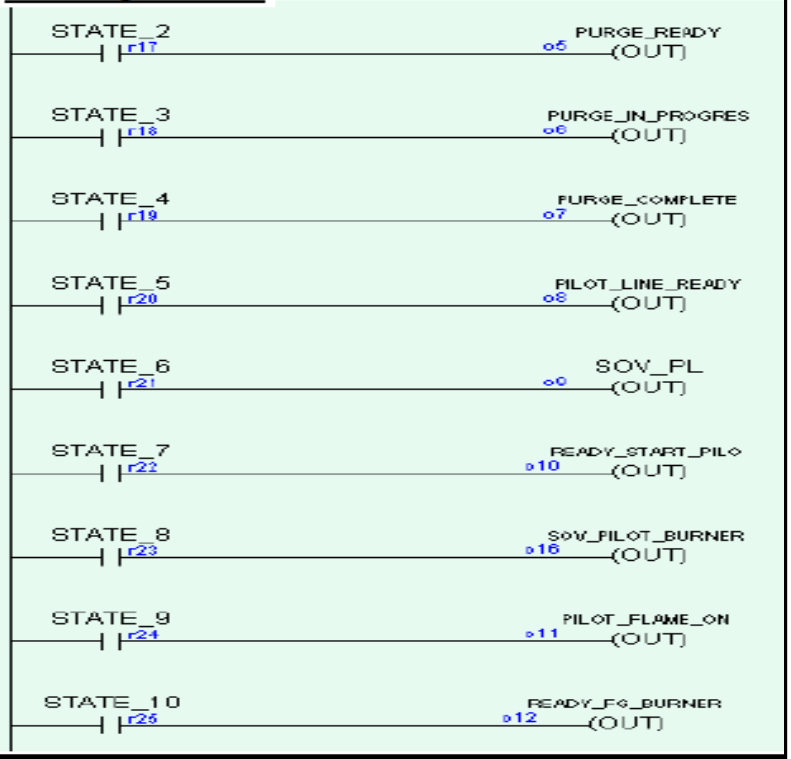
Transitions:

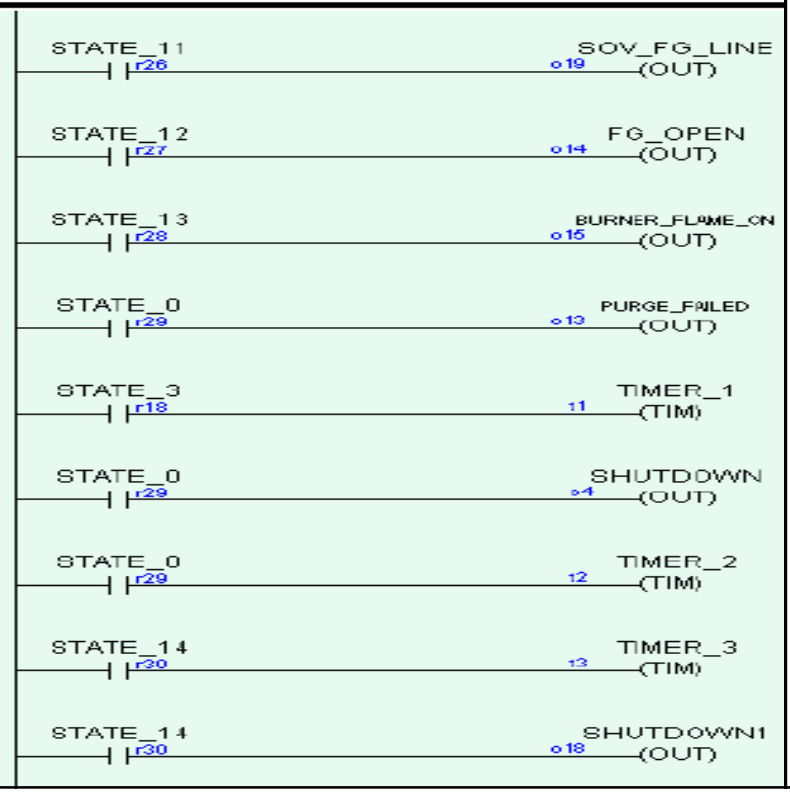


Sequential function chart (SFC) of BMS:



Outputs:





States: