



THE SIGNIFICANCE OF RELIABLE PRESSURE CONTROL IN OILFIELD BURNER SYSTEMS

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Burners play an integral role in oil and gas well pads. They generate the heat necessary for separating the oil, gas and water mixture and to keep the gases in their vapor phase during transportation through pipelines. Burners typically use a portion of the gas coming out of the ground as the fuel to produce the flame for heating. The gases extracted from the ground enter the burner skid (commonly referred to as burner fuel train) at a high pressure and hence they need to be pressure controlled for use in burners. This article discusses the challenges facing the burner industry and the importance of pressure control in burner fuel trains.

Introduction to Oilfield Burners

Burners are gas-fired combustors used by oil and gas firms to generate the heat required for process applications. There are three major classifications:

- **Separator Burners**, which provide heat to separation units such as heater treaters
- **Inline Burners**, which provide heat to maintain temperature within pipes and to prevent hydrate formation
- **Tank Burners**, which provide heat to maintain storage tank temperatures

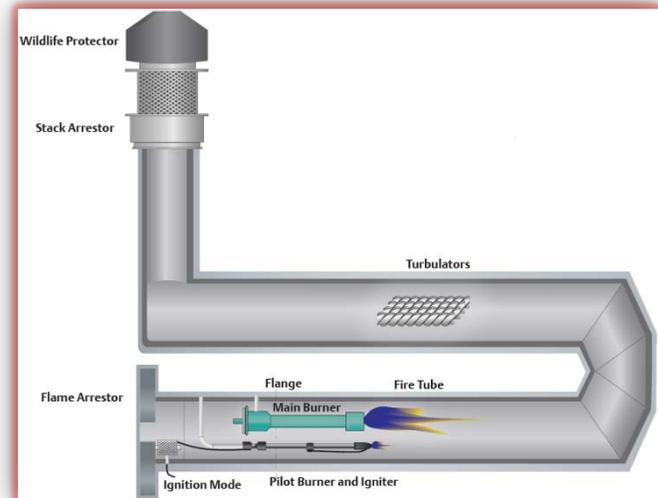
Burners typically operate continuously and play a significant role in upstream oil and gas processing operations.

Traditional Methods of Burner Ignition

Technology and innovation have drastically improved many aspects of safety and production in the Oil & Gas industry. Yet, for igniting a burner, much of the field is using antiquated methods where a worker will use a long stick with a burning rag at the end. This is not only dangerous, but also increases unnecessary downtime as the worker has



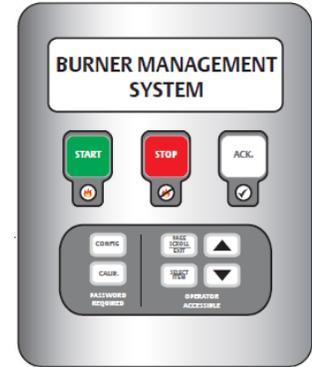
to manually discover when the burner flame is extinguished. Moreover, when the burner is reignited by the worker, it will typically run continuously, often needlessly due to the absence of automation that modulates the flame intensity based on the temperature of process fluid.



Safer, Automated Method - Burner Management System

The potential safety and operational issues with traditional burners is driving the industry towards a safer and automated method through the use of a Burner Management System (BMS). A BMS is an electronic panel that ensures a safer method for control and monitoring of burner units. The BMS operates as the “brain” of the burner systems as it:

- Ensures safe burner startup once proper conditions are met and initiates shutdown if unsafe conditions occur
- Reignites the burner flame automatically in a controlled routine in the event that it has been extinguished
- Monitors and ensures that the burner and pilot flame is lit
- Modulates the burner flame intensity based on temperature needed for the application
- Allows user to monitor flame status, change temperature set points, and even shut down from a remote location



Challenges facing industry today

Although there are many benefits of using a BMS, there are also challenges related to effectively managing the burner systems used in upstream Oil & Gas field applications. These are varied among the different end applications. Detailed below are challenges when burners are used in heater treater applications:

Operational Challenges

The crude oil mixture extracted from the ground is transported along with several useful intermediates (such as ethane, propane etc.) to the refineries where they are refined, processed and sold separately. These intermediates, which have high volatility, add more value and revenue to the crude being transported.



When the crude oil mixture is over-heated ($>110^{\circ}\text{F}$) in the treater, the intermediates vaporize and get vented into the atmosphere or get flared. When the crude oil mixture is under-heated ($<110^{\circ}\text{F}$), water is carried over along with crude due to poor separation. The water has no value and hence reduces the quality of the crude being transported. Both these cases result in revenue loss for the producer.

Safety Challenges

The burners that are used in heater treater applications will need to control flame intensity so that the process fluid, typically crude oil mixture, is heated, stored and transported at an optimum temperature. The United States Department of Transportation (DOT) regulations require that the crude oil mixture transported by rail be maintained at a vapor pressure rating of 13.7 or lower and temperature of 110°F.

When the crude oil mixture is under-heated (<110°F) in the treater, the VOCs (Volatile Organic Compounds) are poorly separated from the oil. This leads to transportation of crude oil that carries an increased risk of boiling when exposed to atmospheric pressure at ambient temperature, resulting in pressure buildup inside the rail car. The excessive pressure buildup could potentially lead to rupture. On the other hand, when the crude oil mixture is over-heated (>110°F) in the treater, the lighter gases evaporate, resulting in flaring when sufficient infrastructure is not available to contain them. The environmental challenges posed by flaring have made several states enforce ban or place severe restrictions on it. Overall, maintaining the crude mixture at the optimum temperature and pressure is critical to the safety of the environment.

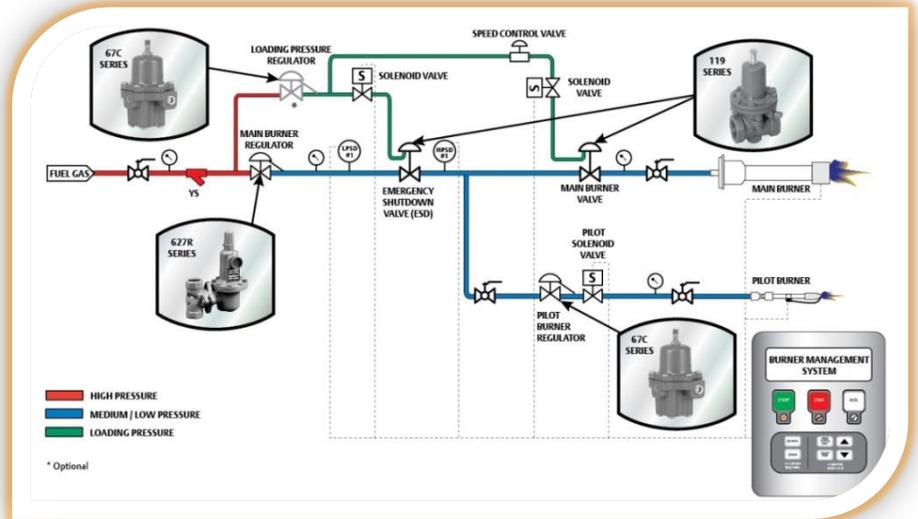


The above mentioned challenges can be addressed safely and operationally by using a combination of pressure regulators and valves along with the BMS.

Pressure Control in Burner Fuel Trains

The burners in well pads generally use a portion of gas coming out of the separator as the fuel for their operation. These gases are typically at high pressure and hence will need to be controlled and regulated before being fed to the main and pilot head of the burner. There is a series of pressure regulators used in controlling the pressure of fuel gas and maintaining the burner flame intensity. Careful selection from a wide range of pressure regulators is essential for optimal fuel train performance. It is important to make sure that the regulator's maximum operating pressure rating suits the operating pressures to be encountered at the intended location of the burner train. Properly selected and installed reliable pressure control elements along with a simplified fuel train should lead to safe and efficient burner operation. Included here are the schematic and a list of pressure regulators and control valves that might be selected for a typical burner fuel train, depending on the application:

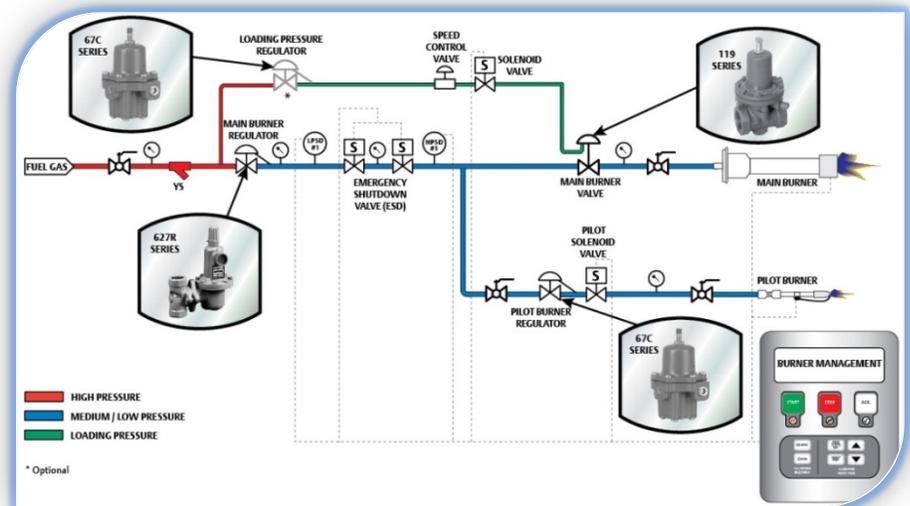
- The **Main Burner Regulator** is positioned at the inlet of the fuel train. The function of this regulator is to reduce the fuel gas supply pressure to the level needed for downstream equipment in the fuel train. The capacity of this regulator will depend on the size of the pipe and the performance and construction of the selected regulator. Insufficient control of supply pressure could lead to damage to downstream



- equipment or a fuel gas leak to the atmosphere. This regulator would typically include an internal relief to help release any excess downstream pressure buildup during an upset condition.
- The **Loading Pressure Regulator** is positioned in the loading line and is used when the maximum pressure rating of the main burner valve is less than the supply pressure. This regulator would reduce the supply pressure to the level required for optimal operation of the main burner valve and is generally not needed when the loading line is connected downstream of the main burner regulator.
- The **Speed Control Valve** is a restriction placed in the loading line to the main burner valve. During startup, this valve aids in more controlled igniting conditions by adding time to allow proper gas to air mixture for smoother combustion. The absence of this valve could result in a sudden inrush of fuel gas to the main burner, extinguishing the pilot burner or causing backfire.
- The **Main Burner Valve** also is used to control the flow of fuel gas during startup. This valve would open or close based on the pressure sensed in the loading line. When the loading pressure is within the operational range of the valve, it will open and allow the flow of gas. If not, the valve will close and block the flow to the main burner, thereby extinguishing the flame.

- The **Pilot Burner Regulator** is located in the pilot line of the fuel train. This regulator is set so that proper gas pressure is maintained to meet the optimum pilot burner design requirements and to ignite the main burner.
- The **Emergency Shutdown Valve (ESD)** is used for immediate and safe shut off of fuel gas supply to the burner when unsafe operating conditions are detected by the BMS. It is a

critical valve in the burner fuel train as it supports the safety and reliability of burners. There are countries such as Canada that require this valve to comply with CSA



Standard B149.3. This standard enforces the use of either a proof of closure enabled valve or the use of two solenoid control valves placed in series (as shown in schematic).

- In addition, there are electronic **Solenoids** in the fuel train that are connected to the BMS. These solenoids open or close leading to starting or stopping the flow of gas in the fuel trains based on the signal received from the BMS. They are also critical to support proper and safe operation of the system.

Sequence of Operation

Startup

During burner startup, the BMS keeps all the solenoids closed for a pre-programmed purge time, ensuring residual gas flows out of the fuel train. After purge, the ESD and pilot solenoids open, allowing the gas through the pilot line and sparking the pilot. Once the BMS confirms that there is a flame in the pilot head, the solenoids in the main and loading line will open. In the loading line, the fuel gas flows through the restriction in

the speed control valve that slows the flow of gas to the main burner valve. In response, the main burner valve would open progressively to allow the gas in the main line to the burner, thereby supporting safe and steady lighting of the burner. During normal operation, the BMS regulates the temperature by closing/ opening solenoids in the main line.

Shutdown

During shutdown, the BMS sends a signal to all the solenoids to close. The closing of the solenoids in the pilot line blocks the fuel gas flow to the pilot burner, thereby extinguishing the pilot flame. The closing of the solenoids in the loading line stops the fuel gas flow to the main burner valve which would close and block the flow to the main burner, thereby extinguishing the main burner flame.

Emergency Shutdown

Once the BMS detects unsafe operating conditions, it sends signal to the solenoid on the ESD valve to close. The ESD valve would respond quickly and shut off flow of fuel gas downstream to both the pilot and main burner, thereby extinguishing the burner flames.

Conclusion

Increasing safety concerns, tightening regulations and industry-wide efforts to achieve greater efficiency are all fuelling a move toward automated control of burners in well pads through the use of Burner Management Systems. It is essential for the safety of the burner train and downstream equipment that the pressure of fuel gas entering the train is controlled appropriately. Different types and sizes of pressure regulators are installed in the train to achieve the desired pressure control. In addition, the pressure regulators help maintain the flame intensity that controls the operating temperature of process fluid in the burner application. Hence, careful selection of robust and reliable pressure regulators is essential for optimal fuel train performance.