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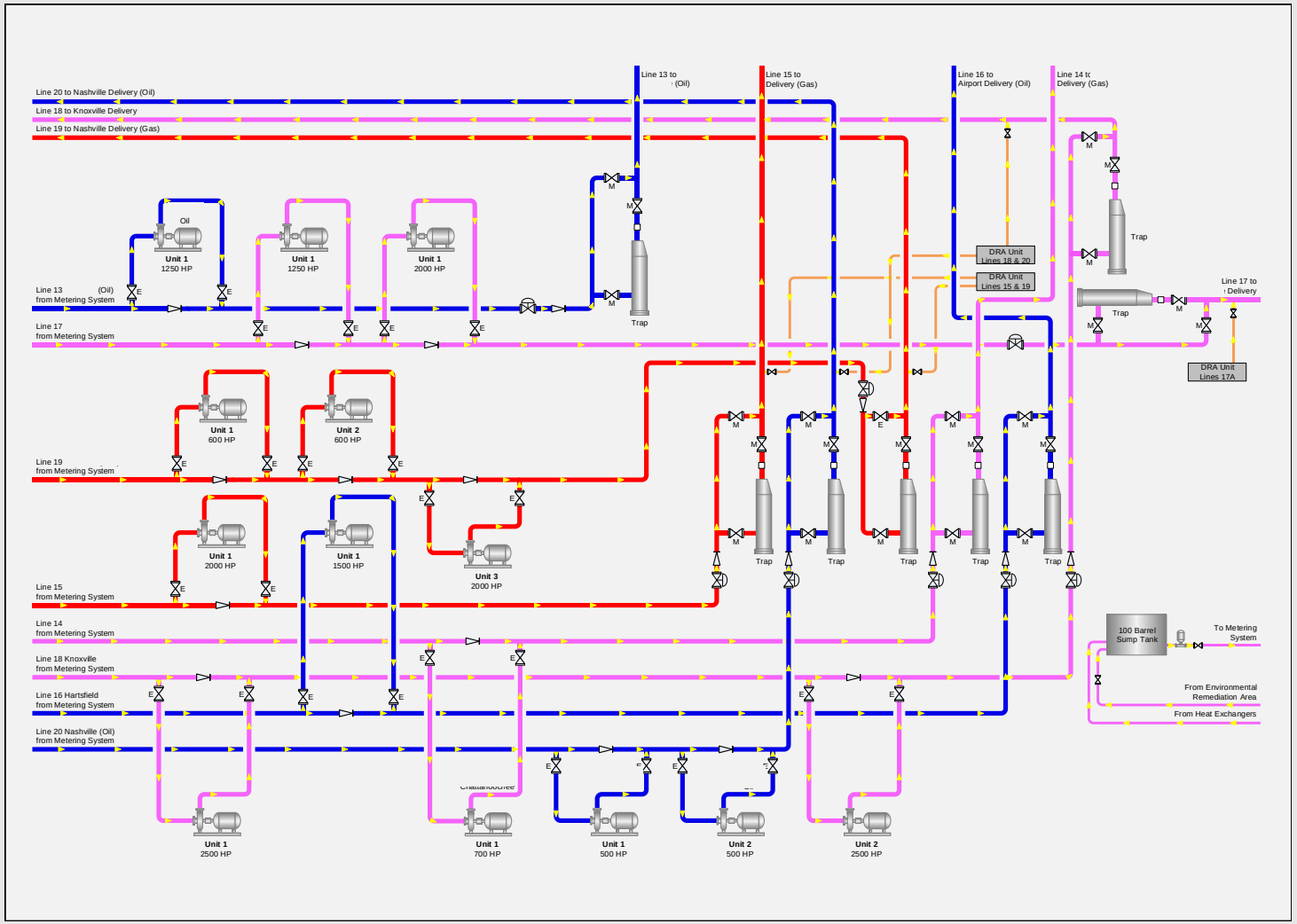
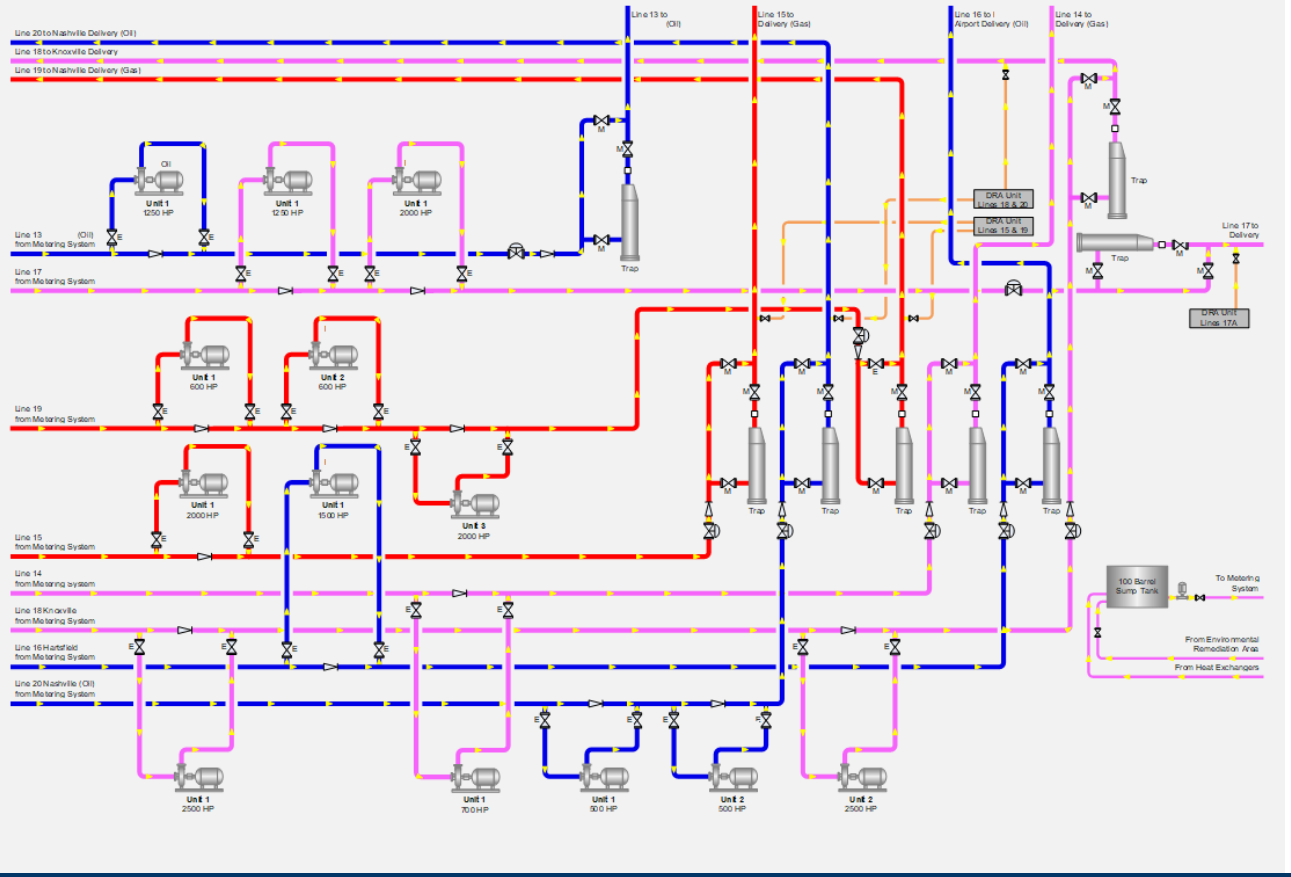


System Drawing

- Developed from Piping and Instrumentation Diagrams (P&IDs)
- Focuses on main process flow
- Major and minor lines
- Directional flow arrows
- Line colors to differentiate material
- Equipment (with name and tag numbers)



Stub Line System

Overview:

A Stub Line is a relatively short pipeline
that supplies product from Atlanta Junction to the delivery location.

In the Stub Line System, there are three Stub Line Subsystems: Gas, Oil, and Mixed Stub Line. These subsystems contain product stub lines that run through the Atlanta Junction facility.

The Gas and Oil Stub Line Subsystems supply gas and oil product from the Product Tanks, respectively. The Mixed Stub Line Subsystem contains stub lines that can transport either gas or oil product from the tanks for delivery.

System Module

- Developed based on the System Drawing, which was redlined by the Client
- Provides detailed descriptions of the process flow
- Illustrates the interaction between the equipment in the system
- Explains why the system is important

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Line 19 contains three pumping Units, and Line 15 contains one. All four pumping Units in the Gas Stub Line Subsystem are in parallel with their respective check valves. This allows for any of the pumping units to be bypassed when not needed.

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The products in both Lines 15 and 19 are discharged from the Pumping Units and pass through their respective pressure control valves.

Purpose:
The pressure control valve maintains suction and discharge pressure in the Pumping Units. A pressure controller first receives a signal from a measurement device. The controller then compares that measured value to a predetermined set point. If necessary, the controller sends a signal to the control valve to make an adjustment to meet the set point.

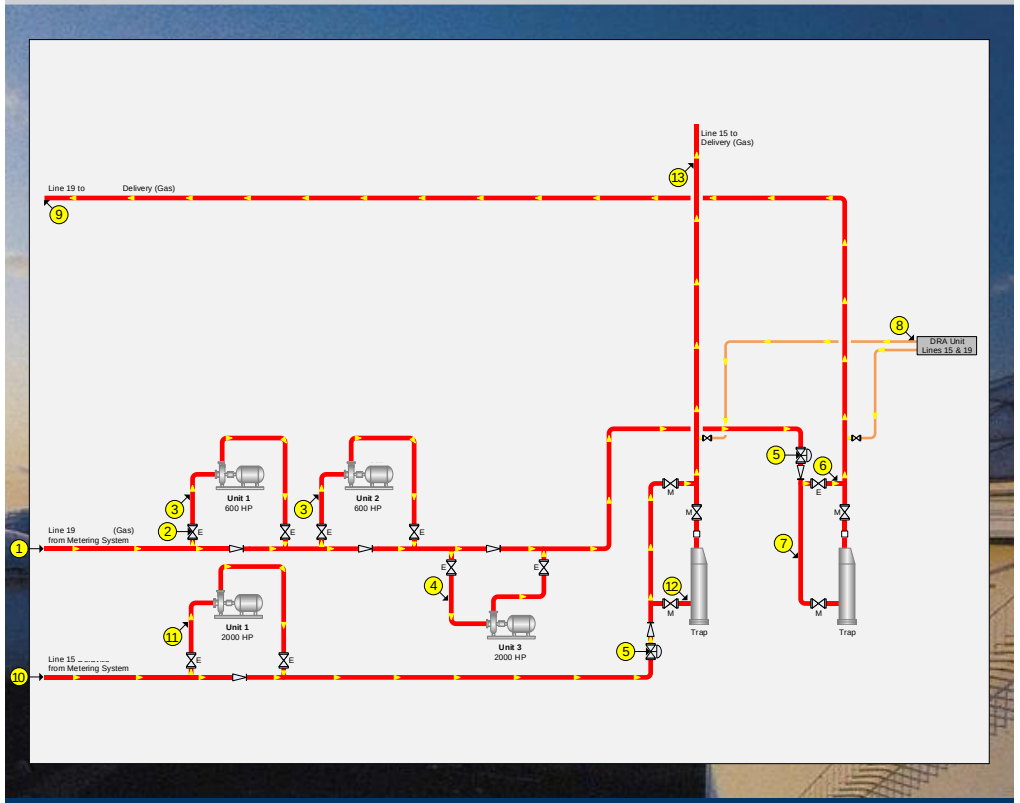
5

During normal operation, the Launching Trap is isolated, and the gas stream flows down the Launching Trap bypass line. Manual valves isolate the trap in order to allow the gas product to flow down the bypass line. Isolation valves stop the flow of fluid to a given location.

6

Overview:

The Gas Stub Line Subsystem contains the and Stub Lines. The Nashville Stub Line starts as a 12" diameter line and transports product from to the Delivery Facility miles away. The Stub Line starts as a 12" diameter line that supplies product miles away to the Delivery Facility. Both stub lines are one directional lines to and respectively. The maximum delivery rate from to is 5,800 bph. The maximum delivery rate from to is 5,100 bph.



Gas Stub Line Subsystem

3

The Stub Line contains one Launching Trap, located downstream of the Pumping Units. The Launching Trap is used for deploying pipeline cleaning and inspection tools called spheres, scrapers, or pigs. When in operation, the pigs are launched from and received at the Delivery Facility.

Purpose:
The pig can be used to sweep the line by scraping the sides of the pipeline and pushing debris ahead. As it travels along the pipeline, there are a number functions the pig can perform, from clearing the line to inspecting the interior. This minimizes frictional losses and optimizes pump efficiency.

7

Drag-Reducing Agent (DRA) is added to Lines 15 and 19.

Purpose:
DRA is a slippery polymer additive that is designed to prevent gas from sticking to the inside of the pipeline. The DRA is added to reduce the liquid friction or "drag" of the flow.

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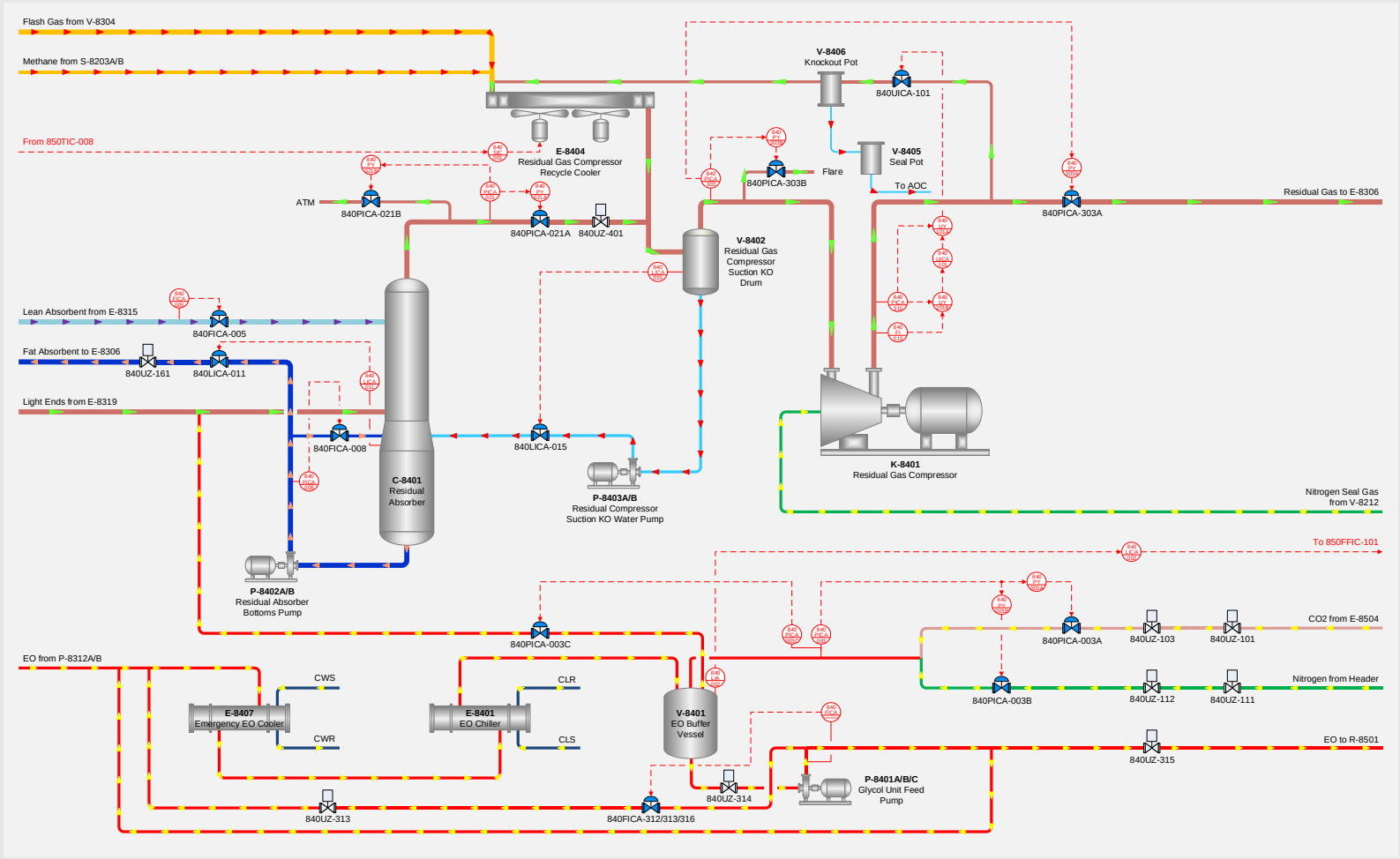
Product flows to Doraville Delivery Facility.

13

Gas
DRA

System Module - Subsystems

- System Drawing broken into subsystems
- Subsystems provide an overview and purpose of a portion of the process flow
- Explains how each subsystem fits into the bigger system
- Uses nodes to identify important aspects in the subsystem and their purpose



Process Control Drawing

- Developed based on the P&IDs
- Used as a building block for the Process Control Modules
- Visual representation of the control loops in the system
- Represents how process flow and process control are related
- Include flow, level, temperature, and pressure controllers
- Illustrate Simple, Cascade, Split Range, and Complex Loops

Controller 840PICA-003 controls the pressure in the EO Buffer Vessel (V-8401). The pressure is controlled using three control valves in a split range configuration. The desired set point is entered into controller 840PICA-003. The pressure is measured by controller transmitter 840PICA-003. In response to a difference between the measured pressure and the set point, 840PICA-003 manipulates control valves PICA-003A/B/C.

If the pressure in V-8401 is very low, controller 840PICA-003 opens control valve 840PICA-003B, allowing nitrogen into the vessel. This will increase the pressure in V-8401 in order to meet the set point.

If the pressure in V-8401 is low, controller 840PICA-003 opens control valve 840PICA-003A, allowing CO_2 to enter the vessel. This will increase the pressure in V-8401 in order to meet the set point.

If the pressure in V-8401 is above the set point, controller 840PICA-003 will open control valve 840PICA-003C. This will vent high pressure gas from the vessel to the Residual Absorber (C-8401) feed in order to meet the set point.

Purpose:
The objective of the pressure controller 840PICA-003 is to maintain the pressure in the EO Buffer Vessel.

1

Controller 840FICA-312/313/316 controls the minimum flow rate through the Glycol Unit Feed Pump (P-8401A/B/C). The desired set point is entered into controller transmitters 840FICA-312/313/316, located on the discharge of P-8401A/B/C. In response to a difference between the measured flow rate and the set point, controllers 840FICA-312/313/316 manipulate control valves 840FICA-312/313/316. This adjusts the flow rate through the Glycol Unit Feed Pump in order to maintain the minimum flow requirement.

Purpose:
Minimum flow protection prevents the pumps from cavitating.

2

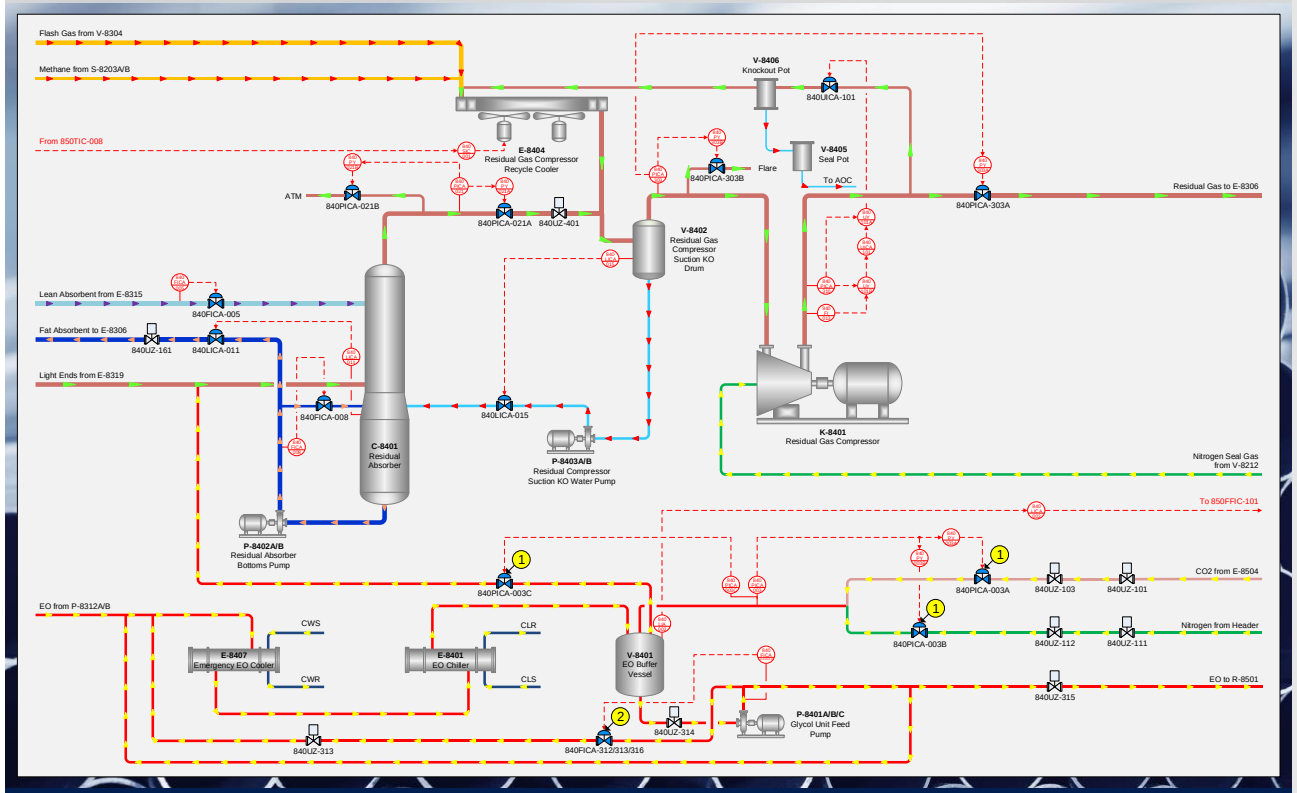
Instrument Signal

Software Link

Connection to Process

Overview:

The instruments in the Light End Removal System control the following: pressure and level in the EO Buffer Vessel, minimum flow rate through the Glycol Unit Feed Pumps, feed flow rate to the Residual Absorber, pressure and level in the Residual Absorber, pressure and level in the Residual Gas Compressor Suction KO Drum, discharge pressure from the Residual Gas Compressor, and temperature of flash gas.



Light End Removal System

Process Control Module

- Explains the function and purpose of process controllers under normal operation
- Provides the operator with visual representation of how the process is controlled
- Provides detailed description of the components and logic behind each control loop in the system

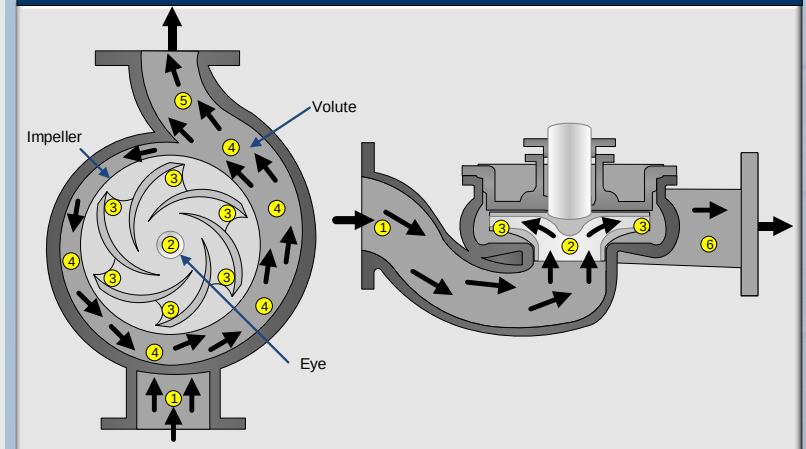
Vertical Inline Centrifugal Pump

Various pumps are used in centrifugal, sump, and positive displacement. This image shows a vertically mounted, single stage, centrifugal pump. All centrifugal pumps operate using the principles discussed, regardless of shape, size, number of stages, or orientation.

How It Works

1. Liquid is forced into the suction of the centrifugal compressor.
2. Upon entering the pump, the liquid is directed into the eye of the impeller.
3. As the liquid enters the impeller, which is mounted on a shaft and driven by the motor, the rotation of the impeller accelerates the fluid outward. The fluid discharges from the periphery of the impeller at high velocity due to centrifugal force.
4. Upon exiting the top of the impeller, fluid flows toward the pump volute along the walls of the pump case. The volute increases in area for fluid flow, decreasing the speed of the liquid stream. The reduction of speed converts the kinetic energy of the fluid (obtained via the impeller) to potential energy (pressure).
5. The moving, higher pressure liquid approaches the discharge nozzle and is directed through the nozzle by the shape of the pump case.
6. As the pressure energy builds within the pump casing, the pump begins to develop head (a liquid column). As the pump spins, the level of the liquid column constantly increases. Eventually, the top of the liquid column reaches the discharge piping outlet, and the liquid begins to flow.

Drawing



Centrifugal Pump Liquid Flow Path (Front)

Centrifugal Pump Liquid Flow Path (Side)

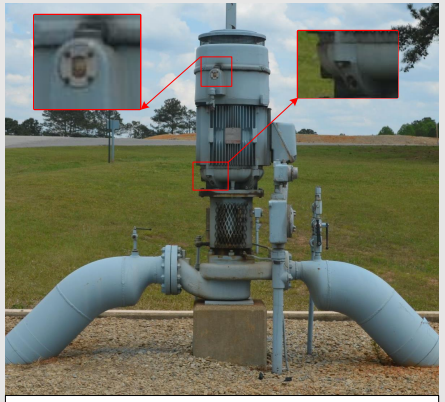
Monitoring

Bearing Oil Levels

Bearing Oil Level

Oil level is monitored through the oil sight glass that is affixed to the side of the bearing housing. Oil is necessary for any rotating equipment to operate. Lack of oil or contaminated oil will cause machine failure.

Refer to the System Operating Pressure Limits (SOPL) on the server to determine the pressure requirements for each line.



Bearing Oil Level

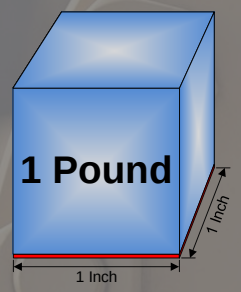
8

Equipment Module

- Developed based on detailed equipment drawings
- Illustrates the internal components of equipment
- Provides an overview and purpose of the equipment and its internal components
- Explains how it works
- Provides the monitoring points

Overview:

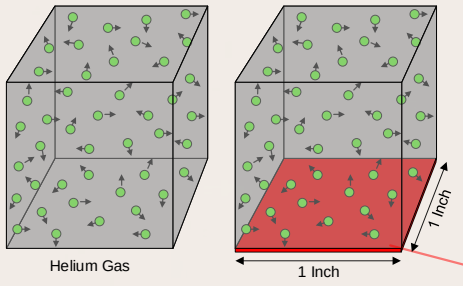
Compression is the process of increasing gas pressure by reducing the volume of the container in which the gas is held. In order to learn about Compression Technology, you must first understand pressure. Pressure is the amount of force acting on a certain area. The figures and text below will help you to understand the concept of pressure.



Pressure is the measurement of the force applied to a certain area. Another term for force is weight. This means that your weight divided by the area of your feet is the pressure that you exert on the ground as you stand still.

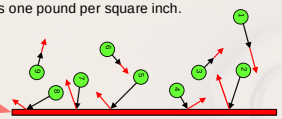
Similarly, a one pound bottomless box filled with water resting on a 1 square inch surface (red), exerts an average pressure of one pound per square inch, or 1 PSI.

Pressure



The water in the blue box is emptied and the box is filled with helium gas. Gas is made up of countless molecules (green circles) constantly traveling through the space inside of a container. As the gas molecules move inside of the container, they collide with the walls of the container and each other. These collisions exert a force on the inner surface of the container.

Instead of the weight of water exerting a force on the red area, the constant collision of countless helium molecules now exerts a force on the red area. If the total force of all of the gas molecule collisions on the red surface at any time is one pound, the pressure exerted on the bottom of the container is one pound per square inch.



Gas Pressure Inside of a Container

As mentioned above, gas is made up of countless molecules traveling through the space inside of a container. In the Figure 1, the container happens to be a compressor cylinder that is sealed with a piston and valves.
The gas contained in the compressor is at a constant pressure and temperature. The space inside of the cylinder is the same as volume of the gas.
At these conditions, the gas molecules are constantly moving around inside of the cylinder. As the gas molecules move inside of the cylinder, they collide with the walls of the cylinder, the top of the piston, and each other. These collisions exert a force on the inner surface of the cylinder and on the top surface of the piston.
This force applied by the gas molecules over the entire inner surface of the cylinder is the gas pressure. Pressure is simply the force that is applied to a certain area. In most cases, it is in units of pounds per square inch.

From the ideal gas law, we get the following relation:
$P_1V_1 = P_2V_2$
When the volume of a gas decreases, pressure increases.
When the volume of a gas increases, pressure decreases.

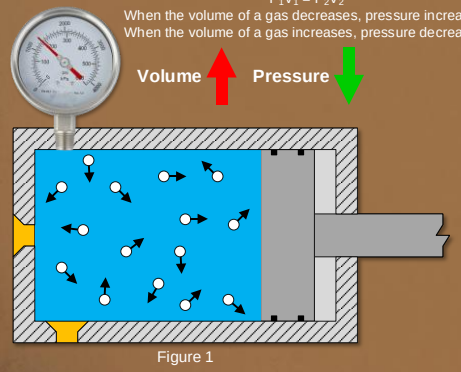


Figure 1

Ideal Gas Law: PV=mRT
Pressure x Volume = Mass of Gas x Gas Constant x Temperature

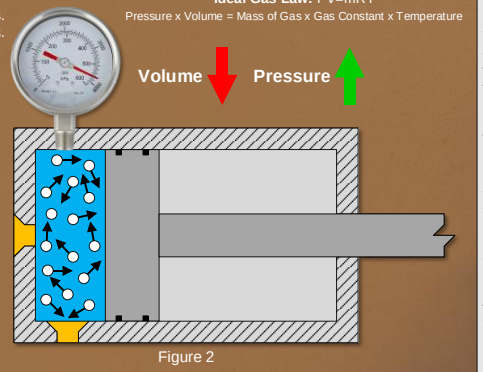


Figure 2

When the pressure of gas must be increased, there are a few ways to do so. You can either add more gas to the container, heat the gas in the container, or the most common way is to reduce the volume of the container.

In the figure to the left, the volume inside of the cylinder is decreased by the piston moving forward. When this occurs, the pressure increases because there is the same amount of gas in a much smaller space.

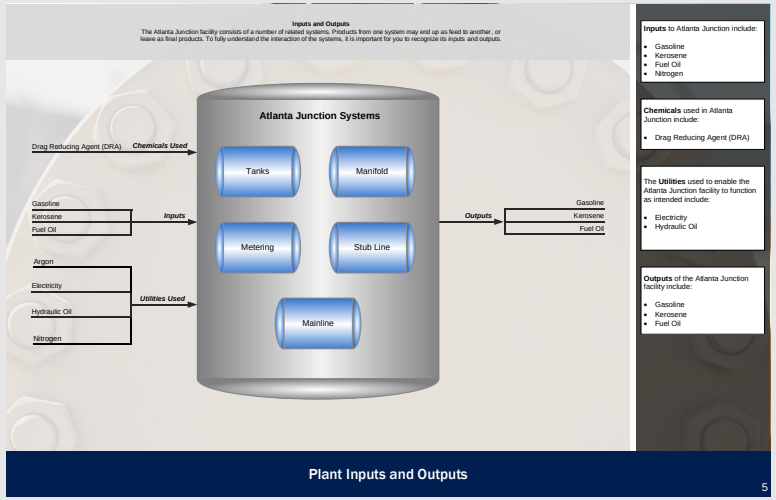
Since the gas molecules don't have to travel as far to collide with the walls, there are many more collisions at any time. This means that there is more force applied to the inside surface of the cylinder. More force applied to any certain area results in a higher pressure.

Compression Technology

5

Process Technology

- Provides the operators with a basic understanding of chemistry and physics behind major technologies utilized in the facility or unit
- Allows the operator to build on the knowledge of how system processes work
- Discusses operational relationships
- Example technologies: compression, fractionation, absorption, adsorption, neutralization



Plant Inputs and Outputs

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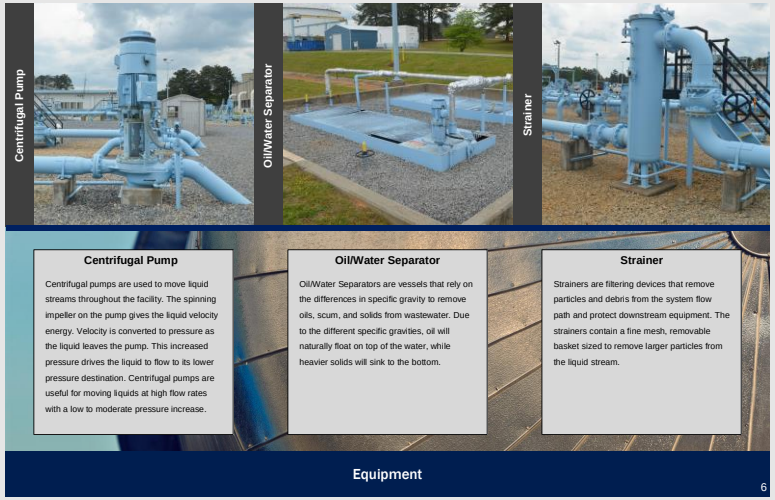

Equipment

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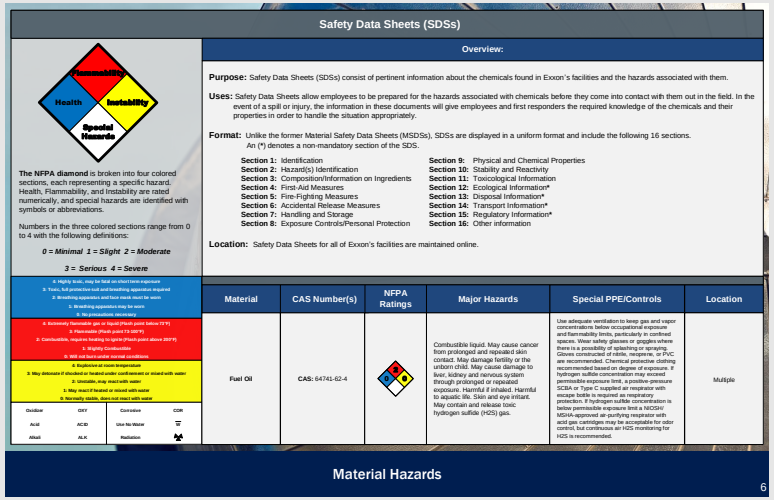

Material Hazards

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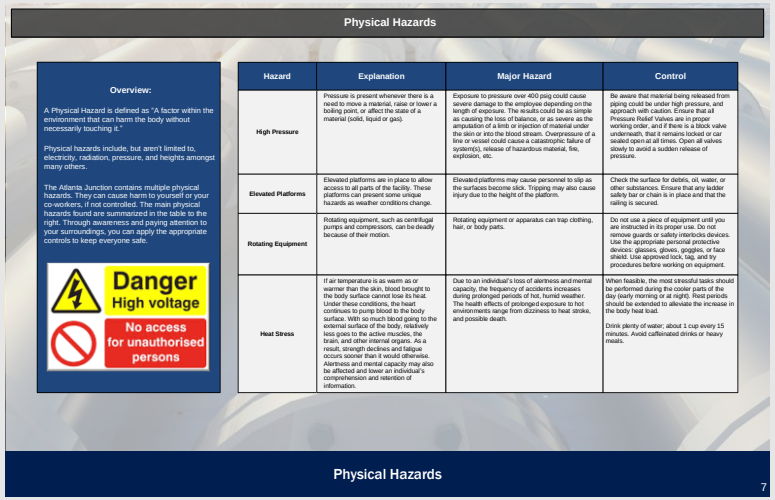


Physical Hazards

7

Facility/Unit Overview

- Provides a brief overview of the facility
- Discusses facility inputs and outputs
- Briefly discusses the types of equipment used in the facility
- Depicts a simplified flow through the facility
- Discusses material and physical hazards
- Discusses general safety and health considerations associated with the facility

Overview:

The American Petroleum Institute (API) Gravity Test is performed at Pipeline in order to compare the density of an oil product sample to that of water. API Gravity is unitless but is often referred to as having units of temperature (°F). This test is performed in the Atlanta Junction Lab Building once a shift to compare against the API gravity value in the control room, during every batch change, and when tank products are switched.

Materials Required

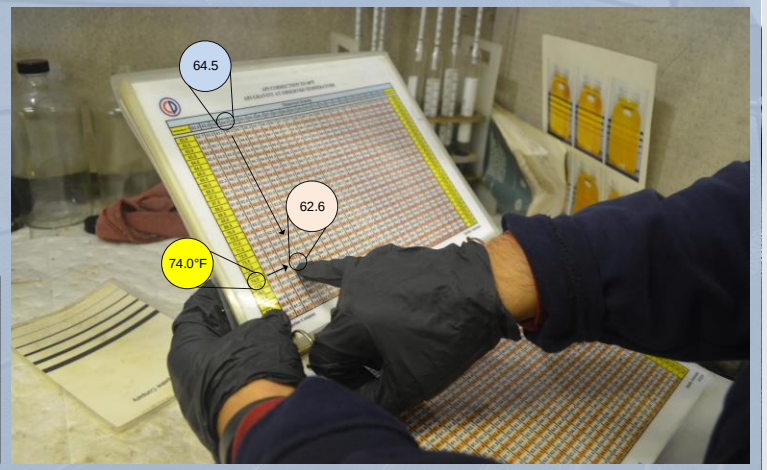
- API Correction to 60°F Chart
- Stopwatch or clock
- Hydrometer
- Sample well

Preparing the Sample

1. In the hood, open the ball valve for the line being sampled. Allow the product to fill the sample well.
2. Choose a hydrometer that will measure gravity in the expected product range. Carefully slip the hydrometer into the sample well.
3. Flush the sample by allowing fresh product to flow through the sample well for 2-3 minutes. This will ensure a representative sample.
4. The hydrometer will bob up and down in the cylinder as the sample is flushed.
5. Shut off product flow through the cylinder. Allow the hydrometer to stabilize.

Reading and Correcting the Observed API Gravity

6. Once the hydrometer stops bobbing, read the gravity at the top of the liquid level, as well as the temperature.
7. Obtain the API Correction to 60°F Chart. Because API gravity is temperature dependent, the observed API gravity measurement must be corrected to a temperature of 60°F. Temperature is located on the left or right side of the chart (y axis), and observed gravity is located on the top of the chart (x axis).
8. Using the chart, find the temperature recorded in Step 6. Then, locate the recorded observed gravity value along the top of the chart. The cell at which the temperature row and observed gravity column meet will show the corrected API gravity.
9. Record the API gravity value. This value will later be compared to the API gravity value in the control room to ensure consistency of product.
10. Place the ball valve in the closed position. Drain the sample, and remove the hydrometer.



API Gravity Measurement

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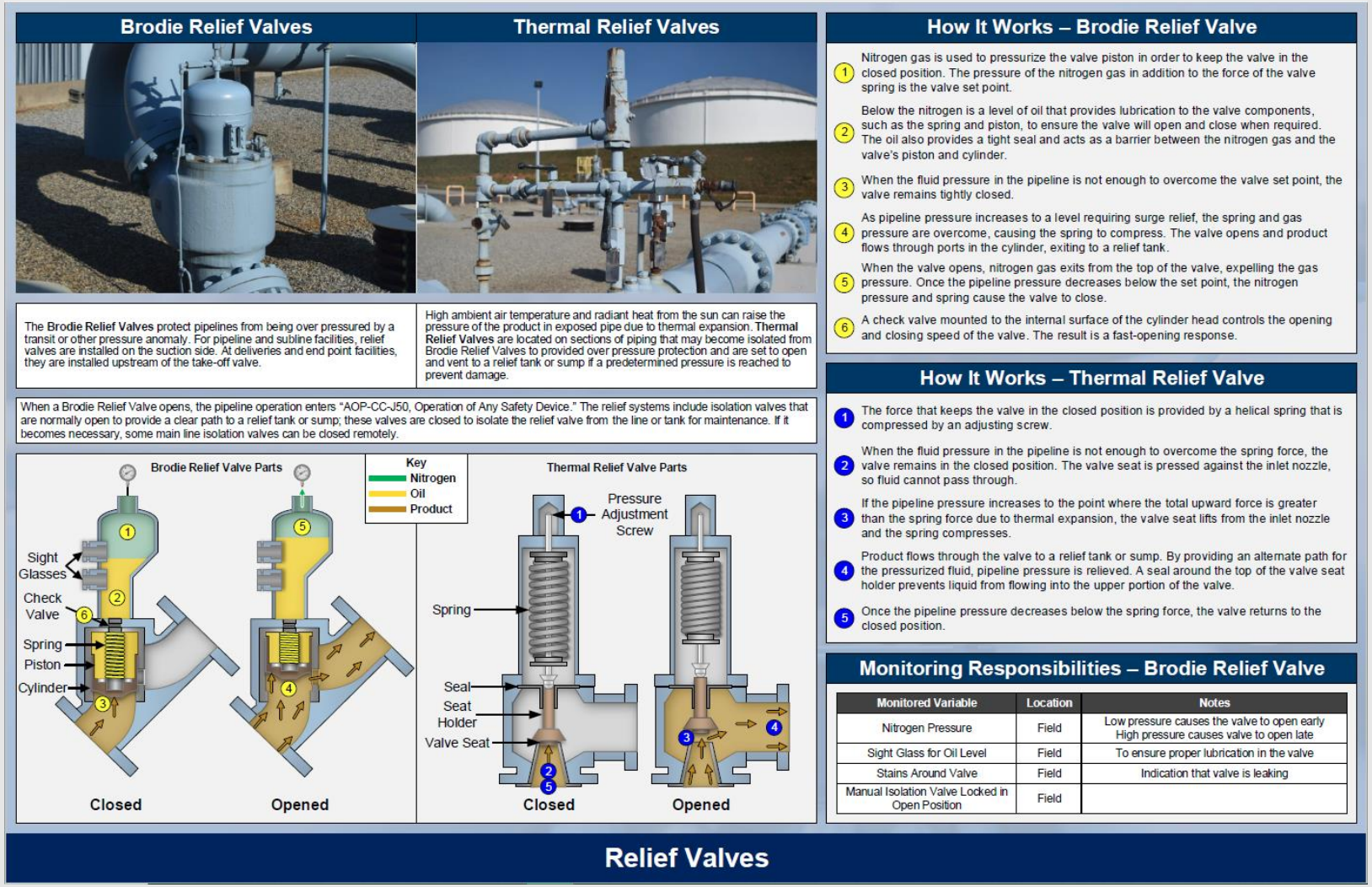
Duties

- Used as a job aid to provide step-by-step instructions on how to perform specific tasks
- Includes the materials needed to perform the task, instructions, and associated pictures to guide the operator



One-Pagers

- A brief overview of a topic, equipment item, or task
- Include images and drawings,
- Explain the purpose and function (how it works) of the discussed topic,
- List main components and monitoring or inspection responsibilities