CCM
OPERATOR'S
MANUAL

Phase Dynamics, Inc.

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Phase Dynamics CCM

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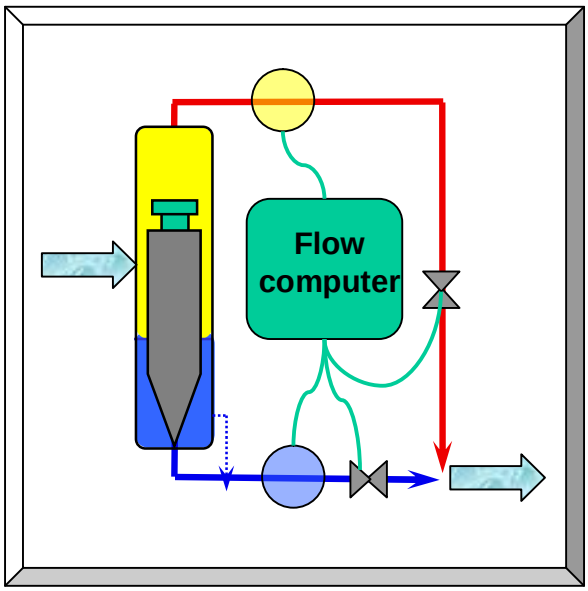
The Phase Dynamics CCM is a completely self-contained stand-alone well-test system. The control electronics are configured to run a well-test with user-specified parameters. The system can be configured from the front panel switches or through digital communications via the available communication port using the Modbus protocol.

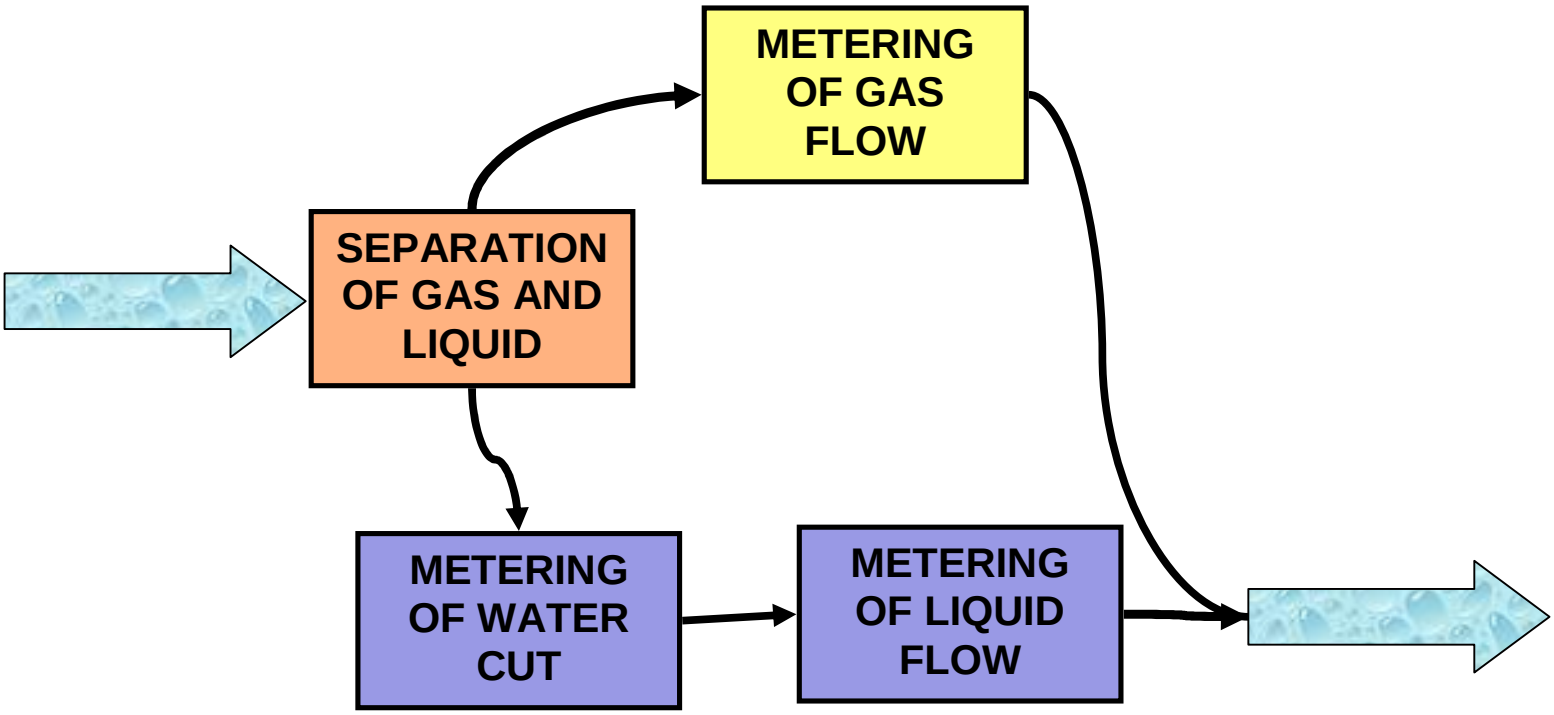
The Phase Dynamics CCM controller is based on the field-proven Full Range Analyzer electronics. The system is actually an extension of the enhanced analyzer electronics with an additional analog input /output board. Most systems will also utilize Modbus communications to obtain process information from the various sub-components of the CCM. This usually includes the pressure transmitter and flow meters as well as some valve positioners.

The Phase Dynamics CCM software also contains the Full Range Analyzer software. Multiple PID Loops have been implemented to control the CCM separator. Various manual and fail-safe conditions are also included in the normal operation of the CCM software.

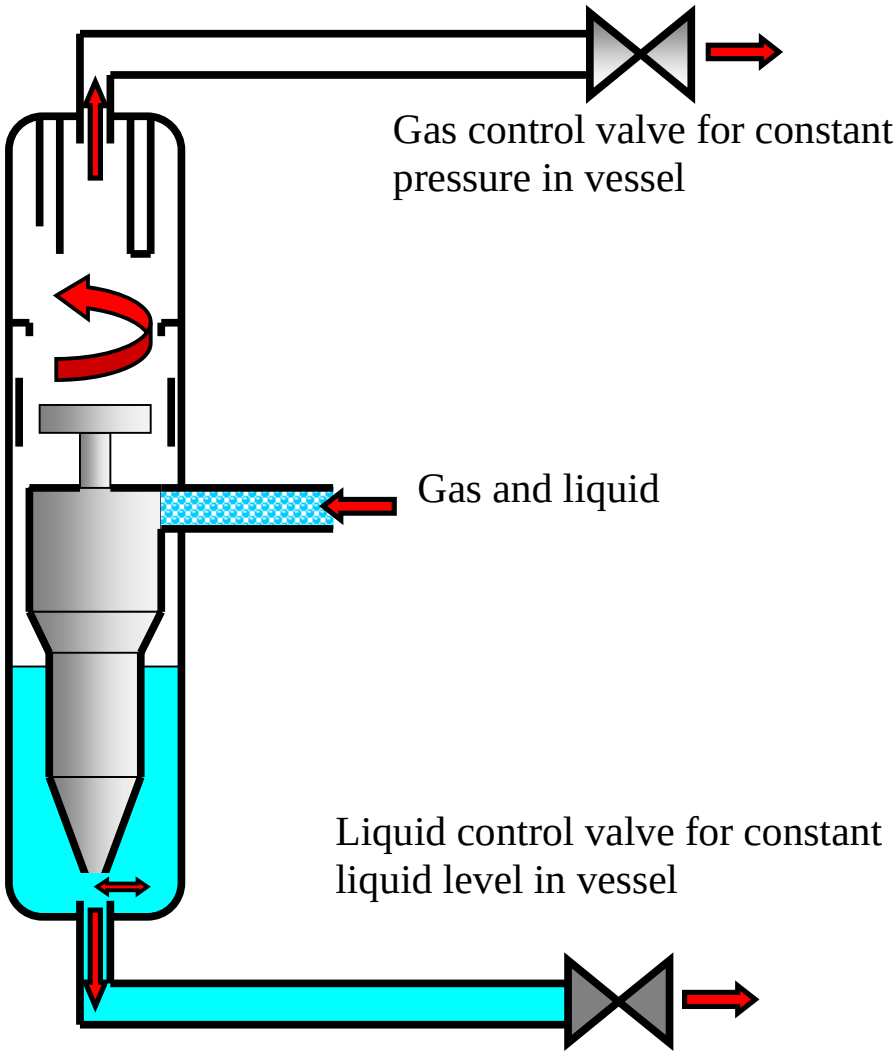
The following sections will describe the theory of operation of the CCM and a typical MMI (Man-machine interface).

The CCM consists of the gas-liquid separator, level/pressure transmitter, water-cut analyzer, gas and liquid flowmeters, gas and liquid control valves, and the flow computer. This is shown in the following picture.





The well stream enters the vessel at approximately two-thirds the height of the vessel. The fluids and gas fill the spin chamber until they are forced through the vanes of the spinner located at the top of the vessel. The spinner vanes will create a cyclone with enough velocity to create a centrifugal force of 100 G's to separate the liquid and gas.



The gas escapes through the vortex finder on the top of the cyclone chamber. It then passes through a second stage scrubber and a third stage polisher. These two stages help ensure that the gas has as little liquid vapor as possible. Excess vapor drains down the side of the vessel where it combines with the liquid to exit the bottom of the vessel.

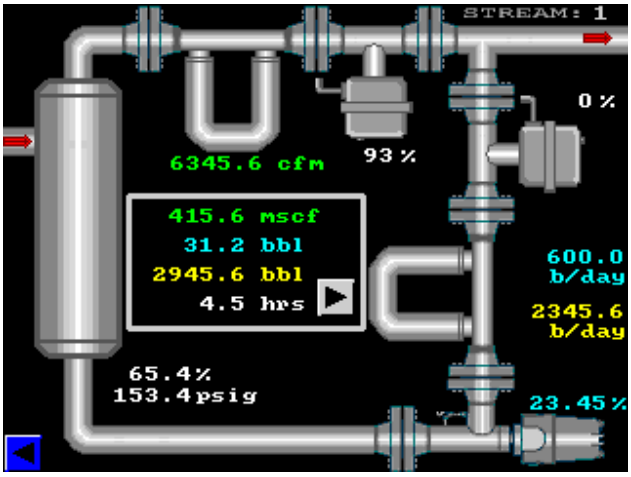
The two down-stream valves are used to control the separator. The gas control is used to maintain a constant pressure in the vessel. The liquid control valve is used to maintain a constant liquid level in the vessel.

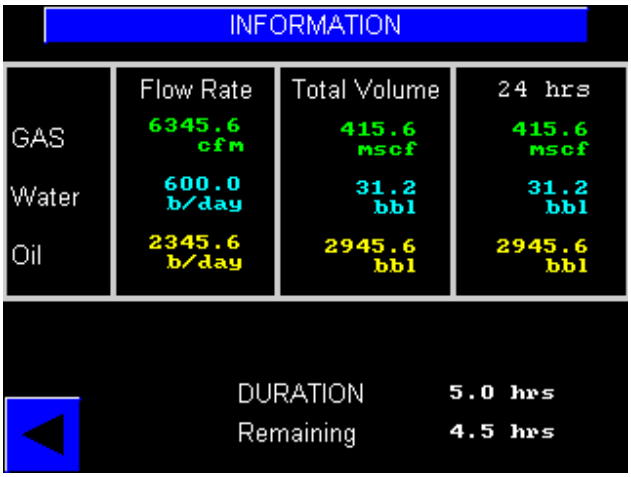
A multi-variable pressure transmitter is used to provide the control electronics with both the liquid level and pressure within the vessel. The control electronics has two PID loops to operate the control valves.

The CCM uses a Phase Dynamics Expanded Enhanced Water-Cut Analyzer to determine the amount of water in the liquid leg. The analyzer requires the salinity of the produced water and an oil adjust value for the API gravity.

Coriolis flowmeters are used on both the gas and liquid legs of the CCM. In addition to flow rate information, the density of the gas and liquids is also available. The liquid flow rate is multiplied by the water-cut to provide the oil and water flow rates. The coriolis meters must be zeroed when they are full of the appropriate fluid and there is no flow.

The control electronics performs all the necessary calculations to control the CCM. The PID loops control the cyclone vessel. It also controls the water-cut analyzer functions. The flow computer calculates rates and accumulates volumes. The Operator Interface Terminal communicates digitally with the control electronics with the Modbus protocol.





The screens above show a typical P&ID user-interface and a summary report. Information and parameters such as valve PID control, vessel level setpoint, etc, may be accessed by selecting the corresponding equipment icon in the P&ID user interface screen.

The cyclone vessel is shown on the left with the liquid level in percent. The level is shown in percent of usable cyclone range from 0 to 100 percent. The vessel's pressure is also indicated.

The cyclone does have High and High-High as well as Low and Low –Low alarm points. In the case of a High-High or Low-Low alarm, the user should abort the well test. The unit will not be damaged in either of these conditions, the test will need to be re-started after the upset condition goes away.

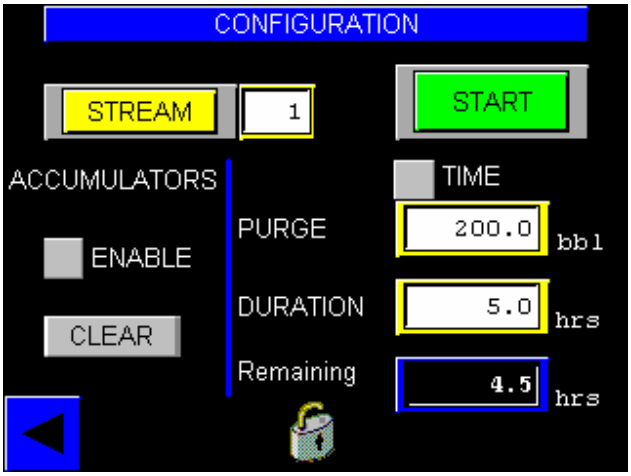
The water-cut analyzer is on the liquid leg. The indicator displays the water content in percent.

The liquid leg's coriolis flow meter indicates the instantaneous water and oil flow rates and total liquid accumulation.

The gas leg's coriolis flow meter indicates the instantaneous gas flow rate and total accumulation.

Both control valves indicate the percentage that they are open. Standard PID parameters are used to control liquid level and pressure in the vessel.

The duration of the test and how much time is remaining can be set using the following screen.



The operator can select which calibration stream in the water-cut analyzer to use. The operator can also set the purge time and length of time for the test. The salinity, water adjust and oil adjust for the water-cut analyzer may also be configured.