Natural Gas Storage
V-Log Solution

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Due to ever increasing seasonal demands, the United States is overtaxing its natural gas delivery infrastructure. With 22 states experiencing peak pipeline capacity utilization in excess of 90%, and little or no hope of quickly adding capacity, operators are placing ever greater demands on storage facilities. Natural gas storage helps to ease the stress on distribution networks by placing energy closer to the end user for consumption during peak periods. Basically, the facilities take in gas during times when demand is low, and supply it during high use periods. This better utilizes the existing capacity by allowing system bottlenecks to run continually at high capacity, delivering the maximum volume of energy possible. In addition, storage facilities are being employed to "park and loan" gas, in order to allow commodity trading, and stabilize seasonal pricing fluctuations. Both of these factors have forced storage facility operations to seek more capacity and to provide quicker injection/withdrawal services.

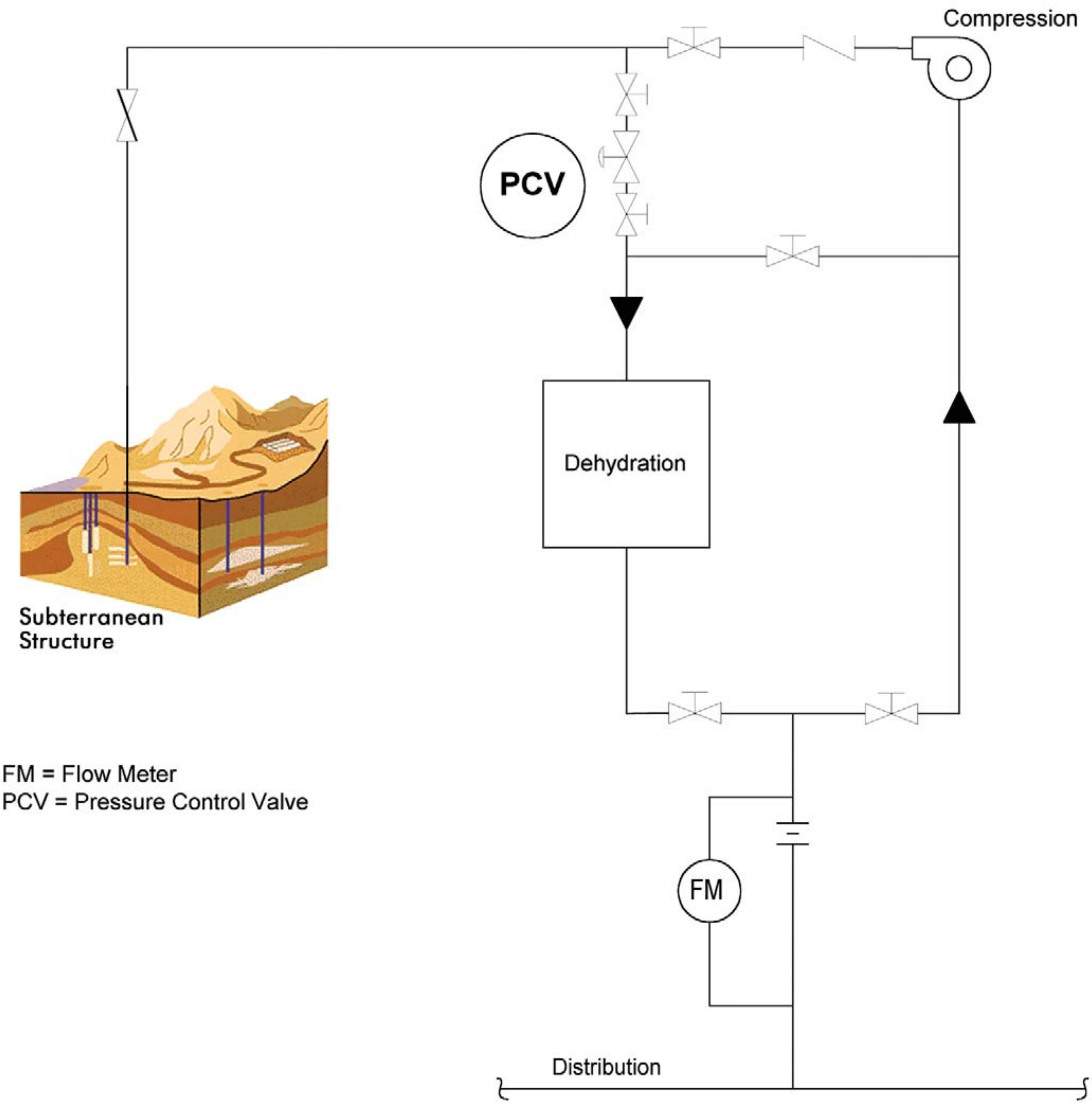
Background

The vast majority of storage capacity in the United States is located underground. There are more than 400 active underground fields in 30 states, with over 100 additional sites planned in the near future!! These facilities are normally one of three different types; Aquifer, Salt Cavern, or Depleted field. Relatively self explanatory, the aquifer style is a reservoir conditioned to hold natural gas, the salt cavern or dome is an empty cavern hollowed out of a large salt formation, and the depleted field is an existing oil or gas field that is no longer productive, but can be utilized for storage. Of the three, the depleted field is the most common, and generally the least expensive to operate. However, the salt cavern method is gaining popularity due to its ability to supply gas quickly during sudden changes in demand. Unlike the other two, a salt cavern holds the gas in a single volume, so withdrawal doesn't require "seeping" the gas out of geologic structure. In fact, the cavern can be quickly depressurized and it's entire contents brought to market in a matter of days, versus the weeks normally required for depleted fields or aquifers. Most of the new storage capacity planned is for the salt cavern type. But all three facilities face the same economic challenges, and changes in storage operations are making the applications much more severe for the primary control valve equipment.

Operational Description

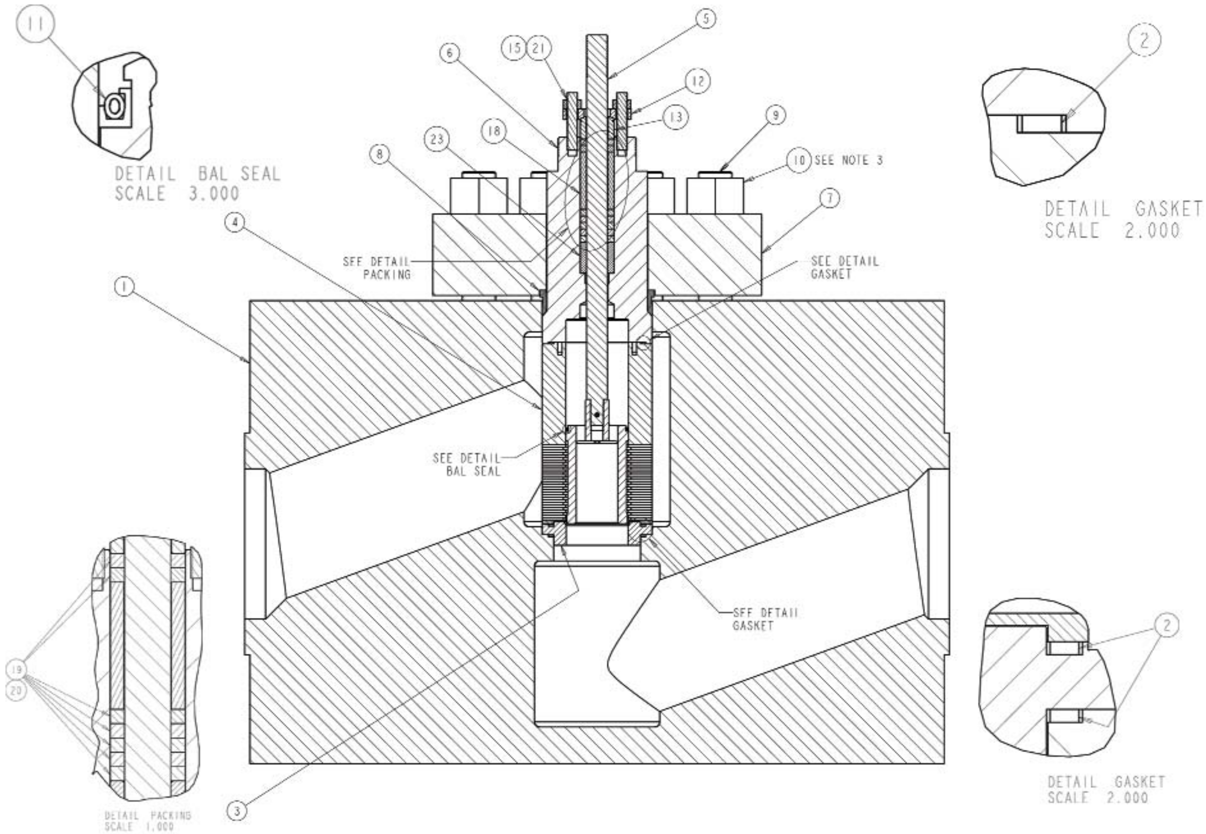
These facilities have a relatively simple principal of operation; During low periods of gas consumption they take gas in, compress it, and place the high pressure gas into storage. During periods of peak demand, the gas is withdrawn, throttled to line pressure and supplied to the system. Typical storage pressures are around 3000 psig and line pressures generally run in the 300-600 psig range. Dehydration must be performed after underground storage because the dry gas will absorb significant amounts of moisture while in contact with the wet strata. Custody transfer metering is conducted during both the storage and distribution activity, as these facilities often store product for a number of different entities, and accurate record keeping is a must. A storage facility acts as a bank, but rather than storing currency, they store the commodity of natural gas. A simple process flow diagram is attached for reference.

Under Ground Gas Storage Facility



FM = Flow Meter
PCV = Pressure Control Valve

Simplified Process Diagram



Valve Related Challenges

Due to the underground location of the storage area and the changing economics of the market, the existing valves may not be up to the task! Operators are being required to increase delivery rates and storage capacity, both of which may create difficulties for the existing pressure control valve. An increase in delivery rate will sometimes require an increase in valve size, but most installations have ample redundant capacity. Generally a site will have multiple compressors, pressure control valves (PCV) and dehydration units. Additional volume may be achieved via simply bringing the redundant systems on-line. However, an increase in storage capacity can only be accomplished via an increase in the reservoir volume or storage pressure. Reservoir volume is generally quite costly to add, so the only option available to the operator may be an increase in storage pressure. Of course, the coincident effect of both increasing flow rates and higher throttling differential pressure will generate significant noise and vibration. Potentially even more problematic may be the onset of hydrate formation, due to the lower throttling temperature associated with the higher ΔP and lower vena-contracta pressure. Hydrates are solid crystalline compounds of gas and water, quite similar in appearance to snow. At elevated pressure, they can form at temperatures higher than the water alone, making their elimination both difficult and non-intuitive. Because hydrates are solids, they can lead to valve erosion and plugging. Velocity control and energy management solutions are a must in order to raise the throttling temperatures, and mitigate any erosion should hydrates exist. Obviously, the formation of hydrates must be avoided! Imagine if during periods of peak gas consumption the storage facility operator had to come off-line due to plugging with ice! The economic penalty of this situation must be avoided at all cost to the operator. V-Log technology is the natural solution to both the noise and hydrate formation problems associated with these applications. The custom-engineered trim is designed specifically to the end users conditions, and throttling temperature prediction is performed at each location of head loss within the trim. Masoneilan application engineering then reviews this data with temp-entropy diagrams for methane (the major constituent in natural gas) and the client to insure hydrate formation is eliminated. Of course, V-Log trim insures proper noise attenuation as well, and our prediction methods fully comply with the latest IEC standards. In most existing installations, the pressure control valve may not employ any noise attenuation trim, so excessive vibration and trim wear may be present. If drilled hole technology is installed, the presence of hydrates will often cause rapid erosion of the cages, plugging of the holes, and plug binding. V-Log technology addresses all of these problems, and due to the reduced part count of our designs, overall maintenance expense can be greatly reduced, while offering much better reliability and uptime!

Case History

A typical valve cross sectional drawing is included for reference. This valve was designed to replace Fisher "A" body valves at a storage facility in Pennsylvania. There are a total of 6 valves, in two trains. The end user was dissatisfied with ever increasing maintenance expense and down time associated with the existing equipment. Masoneilan was contacted and asked to bid on a solution. V-Log was the clear choice, and gave us a competitive edge, because a V-Log valve could be designed to fit into the existing installation, saving the end user major expenses in piping changes. No other competitor could match our proposal! In order to meet the client's shutdown schedule the first three valve bodies were machined from solid forgings, and delivered in less than 10 weeks. The remaining three employed a modified 41000 series body casting, reducing the valve weight and easing the rigging during installation. It is this type of cooperation with a customer that wins Masoneilan new fans in a key industry!

Conclusion

The underground storage of natural gas is increasingly important in today's marketplace, and new operating techniques at these facilities have created challenges to the existing valving. Excessive noise, trim wear, and plugging due to hydrate formation are typical problems associated with these applications, and Masoneilan's V-Log technology has proven to be the clear choice in combating these issues. With lower part count, custom trim, and robust design, V-Log valves will reduce the end users maintenance expense and provide higher equipment reliability than the competition. With the inherent flexibility V-Log laser cut trim provides, Masoneilan can replace existing equipment without changing the customers piping arrangement. These benefits are readily apparent to the facility operator and make V-Log the clear choice in these applications.