Virtual Pipeline®

CryoVST® trailers at the compression mother station, located in Lomita de la Costa, Santa Cruz, Argentina.

Manantial Espejo: the move from isolation and high costs to energy efficiency

Galileo implements its Virtual Pipeline® in the generation of electricity for gold and silver mining in Argentine Patagonia.

An important aspect to consider in the mining industry is the high cost of electricity generation to meet the high demands of energy consumption; the operation of equipments for mineral processing, the lighting and signaling of tunnels and open areas, as well as the workers' living conditions are all factors that call for the generation of electricity on-site. This cost has two dimensions. First, even though power generation is not their core business, mines must produce their own energy. Second, diesel is used to propel these plants. This involves the use of an expensive fuel which has the additional cost of long distance transportation. Moreover, the use of this fuel has an undeniable negative impact on the environment.

"Manantial Espejo": Our Challenge

In 2010, Minera Tritón, a subsidiary of Pan American Silver, faced a situation identical to that described above in the "Manantial Espejo" mine, Santa Cruz Province, Argentina. With a sustained daily requirement of 6 MW of electric power at medium voltage, a significant reduction in operating costs was crucial to replace costly diesel supply with a cheaper alternative. The solution was provided by Virtual Gas Net Company, which involved the adoption of the Virtual Pipeline® —the natural gas transport system developed by Galileo.

Manantial Espejo is a gold and silver mine, whose extraction is performed open pit and underground, covering 17 mineral concessions of 63,093 acres. An interesting fact about the site is the extraction of the 2.910 lb 925 silver bullion used by the renowned Argentine silversmith, Carlos Pallarols, to chisel the chalice prepared for Pope Francis on account of his enthronement.

The mine is surrounded by the arid Patagonian steppe, in an area where dry wind gusts from the west reach speeds of up to 105 mph. In this harsh landscape, the main entrance to the mine is a gravel road that connects with Gobernador Gregores and Puerto San Julián. The former is a small village, about 6 miles away, which shelters workers and their families, while Puerto San Julián is the nearest and most important urban centre, located at a distance of 124 miles.

Alternative Solutions

The first alternative considered by Minera Tritón was to make a power line from Puerto San Julián to the mine, but this proved to be too expensive and impractical. In these circumstances, Virtual Gas Net proposed to replace the diesel-powered generating station by another one driven by natural gas supplied through the Virtual Pipeline® System. The company also took charge of the entire supply of electricity, allowing Minera Tritón to focus on their productive activity.

Thus, the diesel power station of 10 MW installed capacity was replaced by another one driven by natural gas of 8 MW installed capacity. This new station, equipped with five Caterpillar moto-generators, two of them: 3516 Model of 1 MW, and three of them: 3520 Model of 2 MW, which perfectly suited the power consumption of the mine. The new generator set was housed in a building of 229 ft long and 42 ft wide, together with the already existing one, to be used in case of need. In addition, the size of the structure allows for the expansion of the generating plant in the future.

Virtual Pipeline, a solution just right for Manantial Espejo

After having opted for a gas-driven generating station as the most convenient solution, the remaining question was to find the source of gas, which would be supplied through the Virtual Pipeline®.

The first option to be considered was the gas extraction from the network in Puerto San Julián, to be later transported through the Virtual Pipeline®. However, this possibility was limited by seasonal hazard. In Argentina, there is a clear drop in the flow of

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natural gas through the distribution networks during the cold months, a situation that mainly affects industrial consumers.

Considering the flexible configuration of the Virtual Pipeline®, the most convenient option was taking the gas directly from wellheads, whose distance and production capacity would not justify pipe laying investment, and would ensure a permanent gas flow, free from seasonal conditions.

This approach would allow natural gas to be monetized as a result of a productive end; in addition, its use would prevent the negative environmental impact caused by venting.

Virtual Gas Net selected two oil wells operated by Tecpetrol, located in Lomita de la Costa, in Santa Cruz Province, connected to the mine by two roads. The first is a 186 miles road of asphalt alongside National Route No. 3, followed by 124 miles of gravel along the Provincial Route No. 250. The second road covers a distance of 280 miles made up of gravel beside Provincial Route No. 12. In a region like the Patagonian plateau, subjected to harsh winds and snow, having more than one route poses a significant advantage.

How does Virtual Pipeline® work?

The Virtual Pipeline® can bring natural gas by road in the form of compressed natural gas (CNG) to locations distant from pipeline networks. Such system involves three stages before natural gas delivery: compression to obtain CNG, transportation, and pressure regulation at the point of consumption.

The starting point of the Virtual Pipeline® supplying the mine is located in Lomita de la Costa mother station. At this station, two Galileo Core® HP 600 compressors are connected directly to the operator's treatment plant, in charge of the initial separation of the fluids associated to the gas.

Considering that each of the links of the system is located in places that are difficult to access during the winter season, the system was designed with redundant capacity, which remains on stand-by, to ensure continuity in case of unexpected Vcontingency or peak demand. Consequently, only one compressor at the mother station remains active to produce CNG suitable for transport.

CryoVST® trailers providing gas to the power station of the mine

Interior of the new electricity generation plant in the Manantial Espejo mine, Santa Cruz, Argentina.

Since no power network reaches the well, the compressors are designed to generate its own energy from processed natural gas, thus ensuring full autonomy. After the natural gas has entered the compressor at a pressure of 8 bar (116 psi), it goes through an additional liquid separating process, being compressed to 250 bar. Finally, to maximize the transport capacity, each compressor has a Coldbox®, which reduces the temperature of CNG to -4 °F compressing it even more. This last process allows to significantly lower transport costs, since it reduces the amount of freight. Additionally, the freight reduction gives more stability to the supply, since it makes it easier to adjust the freight frequency according to the state of the roads, which may be affected by unpredictable weather conditions.

In order to maintain the CNG at a very low temperature, and achieve the desired savings and flexibility, the CNG is packaged in a special variant of containers equipped with thermal insulation, called Cryomat®. For transport, these containers are mounted in groups of three and fastened securely to CryoVST® trailers. This configuration allows each trailer to carry 185.5 thousand SCF (1,484 GGE) of CNG. This design facilitates logistics, since they can be directly coupled to the load-bearing column connected to the compressor at the mother station, as well as be coupled to the discharge column connected to the pressure regulating plant (PRP®) at the consumption location. These simple operations can be carried out by the driver of the truck himself.

Six truck tractors make twelve trips every three hours 24/7, which amounts to a supply of 56.7 thousand SCF (453.6 GGE) at a total estimate of 1.4 million SCF (11.2 thousand GGE) of natural gas.

Upon arrival at the daughter station located in Governor Gregores, the trucks release the loaded CNG trailers and exchange them for the empty ones, inmediately afterwards heading for their mother station, thus restarting the cycle.

As part of the exchange operation, the CryoVST® trailers newly-arrived at the daughter station are again connected to the PRP,

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which has two sources of regulation, one that is active and the other one as backup. This PRP® decompresses the CNG from 250 (3,625 psi) to 7 bars (101 psi) for delivery within the outlet and inflow pressure range required by the five motor generators.

Virtual Pipeline® logistics is permanently monitored, via Internet, by means of Galileo's SCADA system. This tool allows the remote operator to know how much gas there is in the compression and transport stages, as being supplied through the PRP®. In this way, permanent supply is administered in accordance with demand. This feature, together with the equipment automaticity and the trailer coupling ease, causes the system to operate with minimal workforce, composed by truck drivers, the supervisors in charge at mother and daughter stations, and Galileo's Technical Service regional team.

On the other hand, each of the Virtual Pipeline® stages is configured in modules. This allows the system to increase its capacity at the rate of demand. The scalability facilitates optimal sizing of the system, thus, achieving an appropriate balance between operational and investment costs. This is accomplished by the addition of new modules when the capacity limit is reached; that is, by adding new compressors, CryoVST® trailers or PRP®.

The Final Outcome

Thanks to the Virtual Pipeline® designed by Galileo, diesel consumption in power generation has been completely replaced by natural gas. Consequently, this move has tangibly reduced the operating cost of the mine as well as its pollution footprint. In conclusion, Minera Tritón now may focus on their own business, after outsourcing power supply to Gas Virtual Net.

The silver bullion used for the chiseled cup presented to Pope Francis on his enthronement was extracted from Manantial Espejo mine.

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Project Data:

Main objective

To provide Tritón Minera a comprehensive solution in power generation for "Manantial Espejo" mine. This solution should allow the company to focus on mining, and have its energy consumption operating costs reduced, as well as its pollution footprint.

Solution

- The Virtual Net Gas Company took over the generation of power.

- The diesel power station was replaced by a natural gas driven one with an installed capacity of 8 MW to generate 6 MW of continuous electric power. This new station is equipped with:
  - 3 motogenerator sets of 2 MW each, and
  - 2 motogenerator sets of 1 MW each.
  - The natural gas supply was provided directly from the wellhead through a Virtual Pipeline® System designed by Galileo.

Galileo's Technology and Virtual Pipeline configuration

In the compression mother station, located in Lomita de la Costa, Santa Cruz, Argentina:

- 2 Galileo Core CNG compressors for wellhead®*, equipped with:
  - 600 HP of individual power;
  - Propulsion-based natural gas processing;
  - Inlet pressure of 8 bar (116 psi);
  - Additional liquid separation process;
  - Dryer;
  - Compression at 250 bar (3,625 psi); and
  - ColdBox® system or gas cooling, which reduces its temperature to -4 ºF and increases compression level for greater load capacity and freight transport reduction.

- 2 trailer load-bearing columns for transportation of CNG.

In the transportation of CNG:

- 12 CryoVST® trailers, equipped with 3 Cryomat® containers each, towed by 6 trucks that travel a distance of about 310 miles between the two stations.

- Approximately 1.4 million SCF (11.2 thousand GGE) per day of natural gas transported.

In the daughter decompression station, located at Governor Gregores, Santa Cruz, Argentina:

- 2 columns for the reception and unloading of trailers;
- 1 Regulating Pressure Station (PRP®)*, which decompresses the GNC to deliver natural gas at 7 bar (101 psi) outlet pressure, as required by the 5 motogenerators which they are connected to.

** An operational equipment, and another one on standby to ensure business continuity in case of contingency and/or demand peaks.*

Galileo

Since 1983, Galileo has been a global reference in modular technologies for both CNG and LNG production and transportation. Its portfolio includes the widest range of compressors and pumps for vehicles and vessels; pipeline boosters and wellhead compressors; and the Virtual Pipeline® system, for gas distribution by road, which can reach remote communities and industries without pipeline network connection. Based in Buenos Aires, Argentina, with a Service and Training Hub in Los Angeles, USA, Galileo exports and provides ongoing assistance to customers in 65 countries in Latin America, USA, Europe, Africa and Asia.