Nimble Response Gets Kuwaiti Power Plant Online Quickly

By **Billy Sumbles, Valerus Compression Services,** Houston

Fuel Gas Booster Station

The Middle East is experiencing high immigration rates due to the steady oil-based economy that is luring workers from around the world. Kuwait has one of the highest immigration rates in the world. The country's population is made up of 1 million Kuwaitis and 2.5 million ex-patriots. The steady influx of workers has placed a large burden on the nation's infrastructure, in particularly its power grid. Kuwait's water supply comes from desalination plants, which require large amounts of electricity to operate. Air conditioning adds another significant electrical load. The annual growth rate in demand for electricity is estimated to be as high as 9%.

During the summer of 2007, demand for electricity in Kuwait outpaced generation capacity, causing rolling blackouts and brownouts. The government quickly authorized funding for 3,400 megawatts (MW) of new generation capacity to be added in the near term. Another 6,000 MW will be added in later years.

Kuwait's summer season lasts from April until October with daily high temperatures exceeding 120 degrees F during June, July, and August. Demand for electricity explodes during these peak periods. The Kuwaiti Ministry of Electricity & Water's first addition was the Shuwaikh Power Plant, a 200 MW plant designed to provide generation at peak periods. Due to the immediate need, the Ministry requested bids for the construction and commissioning of the plant with a seven-month deadline.

Fuel Gas Booster Station

The project was awarded to an engineering consortium lead by S&W Energy. At the heart of the generation station design were six LM 6000 turbines manufactured by General Electric. To maximize the efficiency of the turbines, a fuel gas booster station was included in the overall design and was awarded to Valerus.

The electric-powered, gas fuel booster station was required to deliver 66 MMcf of gas at capacity and raise the inlet pressure of 12 BAR to 42 BAR. To meet this demand, Valerus packaged three, two-throw compressors, totaling 5,000 horsepower. To minimize the amount of hands-on personnel required to operate it, the fuel booster station was equipped with programmable logic controllers (PLC). The booster station would interface with a gas receiver which would store a large volume of gas prior to its consumption in the turbines.

One of the key challenges was the extremely short delivery time: seven months from contract to commissioning. Typical industry lead times for equivalent compression packages run 24 months so the requested schedule of work was far from ordinary. Exacerbating the challenge were penalties of $1 million per day should the compression company fail to deliver on time.

Challenges

In addition to the short time line and large penalties, Valerus had to deal with an unforeseen problem: soot in the supply pipeline. At the end of Operation Desert Storm in 1991, Saddam Hussein's retreating forces set fire to 600 oil wells and the pipelines that connected them.

The resulting fires not only clouded the sky with thick, viscous smoke, but also fouled pipelines with smoky residue, including the one supplying the Shuwaikh Power Plant. This problem only came to light after initial start-up of the fuel gas booster station.

Of the allowable seven-month timeline, engineering, construction, and factory-acceptance testing consumed four months, while shipping added another month. The fuel booster station arrived in Kuwait just five months from contract signing.

During construction of the power plant, a design change was implemented which introduced a time lag into the project, causing Valerus start-up personnel to stand by for six weeks before they could perform the final integration and start-up.

Desert Storm Soot

The fuel booster station was brought online but its PLC-based automation package shut the station down after just one day. Valerus field engineers disassembled the compressors and discovered contaminants covering the valves. A lab analysis of the substance verified later what the field engineers already suspected: 88% ash and 12% sulfur, otherwise known as soot.

The company's start-up specialists had seen similar problems before but never to this extent. The buildup of contaminants inside the compressors usually took several months to affect operation; in this case, fouling occurred within days.

While it is standard procedure to include scrubbers in the inlet pipe to remove liquids and condensate from the gas, filters — which remove solids - are not typically needed unless there is some prior knowledge of a problem. Realizing that soot was flowing down the supply pipeline, Valerus engineered a filtration system to clean the incoming gas.

Due to the heavy particulate level, Valerus engineers integrated three coalescent filters, each capable of handling 50% of the total gas flow. The use of three filters allowed maintenance personnel to change filters without interrupting operations. Particulate down to one micron in size was removed from the gas stream. Sock-style filters were used to make filter replacement easy.

The filters were air freighted to Kuwait from Valerus' facilities in Houston and installed on the inlet pipe. During the transit time, Valerus field engineers disassembled the compressors, conducted a thorough cleaning and then reassembled the compressors. Three days after the initial problem was recognized, the fuel gas booster station was restarted, this time without any interruption.

Completed Project

Valerus was able to shave over a year off the delivery time quoted by competitors. From start to finish, the project schedule for the fuel gas booster station spanned just seven months. Moving quickly, Valerus was able to deal with the unforeseen problem of soot in the supply pipeline, designing and implementing a filtration system, and restoring the booster station to operation in just three days.

The Shuwaikh Power Plant began operation in May 2007, just prior to the searing summer season, supplying an additional 200 MW of power to the Kuwaiti national power grid. The improved reliability of the power grid has had a positive impact on the Kuwaiti economy while enhancing the national living standard. Although the power plant was designed to operate during short term, peak demands for electricity, it has been in continuous operation since start-up.

Valerus was subsequently awarded additional contracts by the Kuwaiti government for the supply, installation and training for fuel gas booster stations at the Az-Zour and Subya Power Plants. ***P&GJ***

Author: Billy Sumbles *is manager of the South East Asia region for Valerus Compression Services, LP, Houston, TX.*