Case Study

Motor Startup and the Use of Dynamic Reactive Power Compensation Systems

The US Natural Gas Industry Case

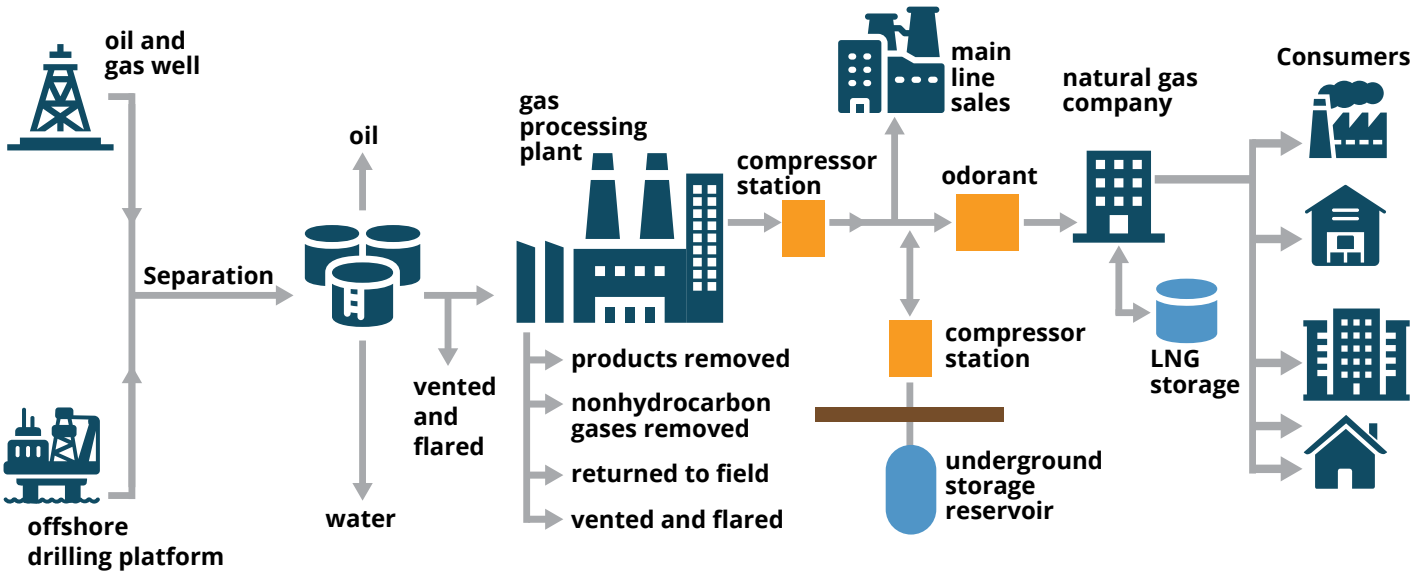
Elspec's Reactive Power Compensation Systems reduced voltage drops during motor startup and stabilized the voltage levels in a gas processing facility in Southern USA.

The natural gas processing industry is a crucial component of the energy sector and plays an important role in the global economy. The processed gas is used for various purposes including heating, electrical generation, and as a fuel for the production of chemicals. Being one of the largest producers and consumers of natural gas in the world, the US has been investing heavily in new processing plants and technologies to improve the efficiency and competitiveness of its operations.

Customer Situation

A gas processing facility in the southern US used a 900kVAr fixed capacitor bank in order to maintain high voltage levels to prevent its large motors from dropping offline during startups. Large motors are used in gas processing facilities to drive various types of machinery and equipment, including compressors, pumps, fans, and turbines. For large motors, the startup voltage can be several times higher than the rated operating voltage. Thus, the motor startup voltage is an important factor that can impact the performance of the motor and the electrical system as a whole.

However, in this case, the capacitor bank increased voltage levels during non-startup periods while the voltage levels during motor startups were still routinely too low and inadequate. The lack of reactors on the capacitor bank also increased the harmonics to undesirable levels. High levels of harmonics can cause a variety of issues in electronic equipment and circuits as well.



Source: US Energy Information Administration

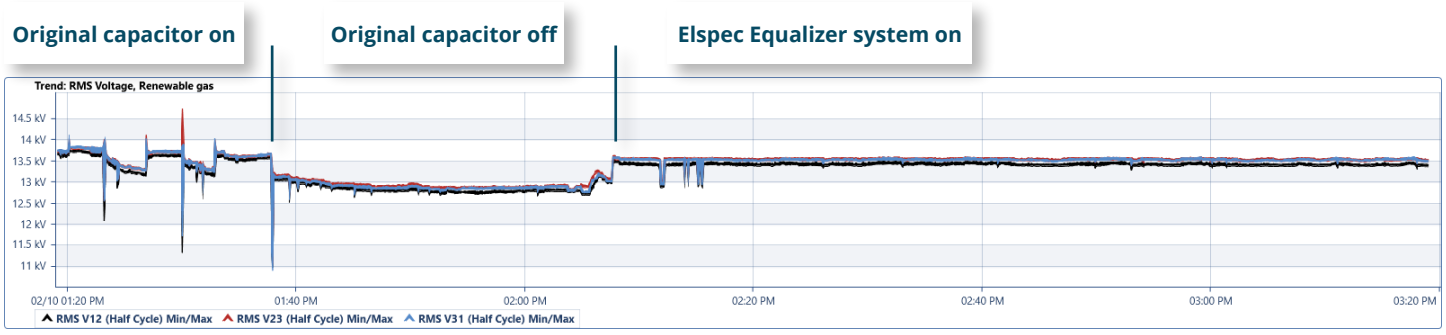
Using Elspec's G4500 portable PQ analyzer with continuous waveform recording confirmed that the 900kVAr fixed capacitor bank was inadequate to support the large motor startup conditions. The data indicated this capacitor bank caused other damage to the network through injecting high voltage and harmonic levels. It was recommended to replace the existing capacitor bank.

Solution

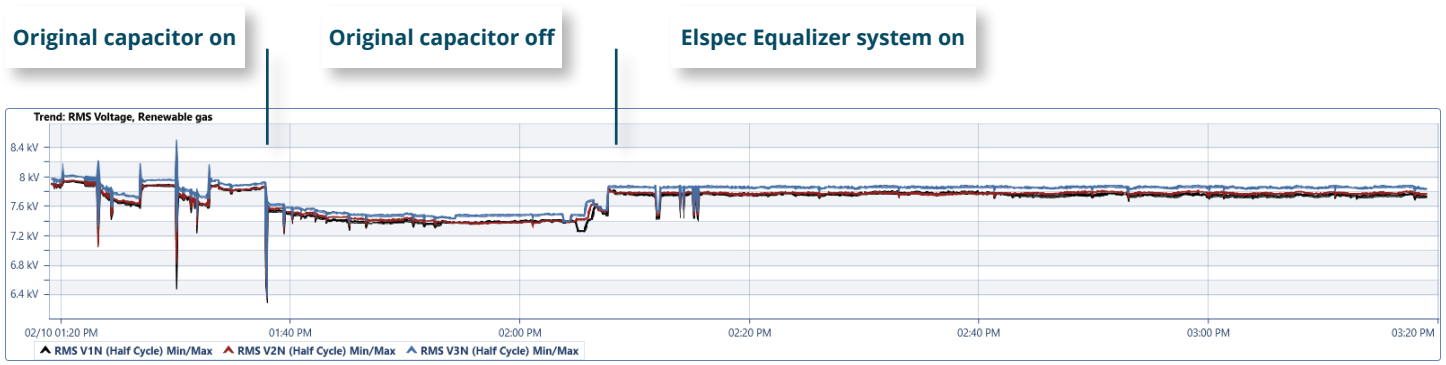
The solution chosen for this customer was a detuned 2,970kVAr dynamic reactive compensation system, Elspec's Equalizer. This system is a unique system that compensates motor startup in real time without creating unwanted harmonics. The system provides transient free smooth switching by connecting capacitors to the network at zero-crossing. The 600V Equalizer system was connected through a step-up transformer and installed on the 13.2kV network.

Results

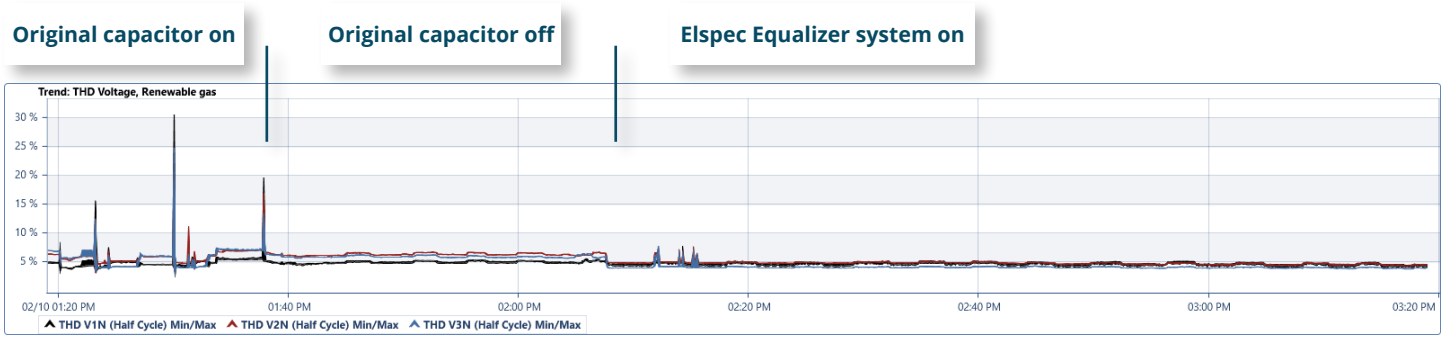
L-L Voltage: With the old capacitors, the voltage had significant variations, reaching lows of 11kV and highs of 14.5kV. After the old capacitors were removed and the Equalizer system was installed, the voltage levels were stabilized at approximately 13.2kV (nominal).



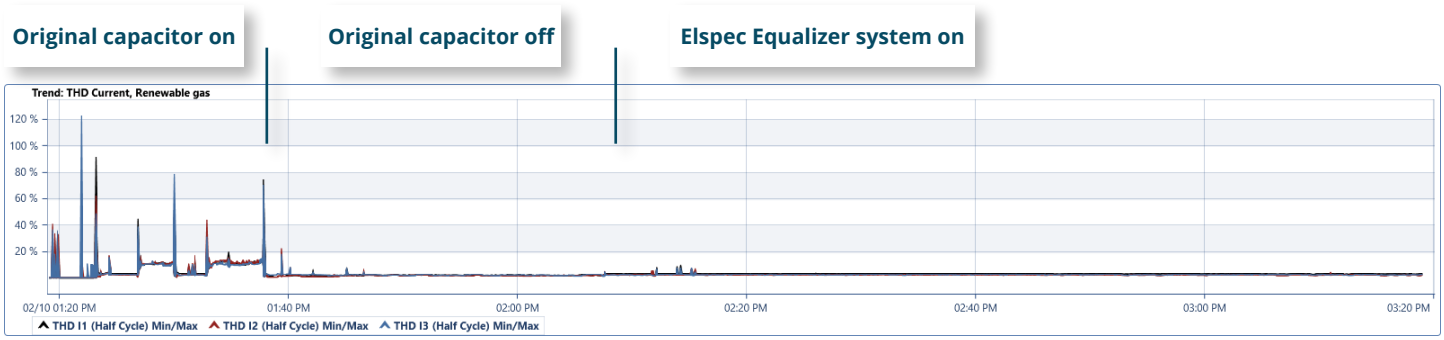
L-N Voltage: With the old capacitors the Line-to-Neutral RMS Voltage varied between 6.4kV and 8.4kV. After the Equalizer system was installed, the Line-to-Neutral RMS Voltage was stabilized at 7.8kV.
Due to the voltage stabilization, the motor start experienced a reduction in voltage sags.



THD Voltage %: Total Harmonic Distortion was greatly reduced after installing the Equalizer system, particularly during startups. The total harmonic distortion for voltage reached a high of 30% during one particular motor startup with the old capacitors connected, and others reaching 15% and 20%. These Harmonic distortions can cause major disturbances in the electrical network and be very harmful to other equipment connected to it.



THD Current %: The total harmonic distortion for current reached as high as 120% with the old capacitors. These levels of distortion can lead to disturbances, degradation and heat rise on other components on the electrical network. The Equalizer system reduced these levels significantly.



Extended follow-up communication with the customer revealed fewer nuisance trips in additional loads after the Equalizer was installed.

Conclusions

Installing the Equalizer reactive power compensation system provided many key benefits such as:
Stabilized voltage at the rated voltage level
Reduced the nuisance trips
Reduced harmonic distortions that were amplified by the original fixed capacitor bank
Improved the motor performance as well as the electrical system performance as a whole.

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