

# REFINED

REE audit in the Mina Al-Ahmadi refinery

Clean fuel is a central corporate goal of the Kuwait National Petroleum Company (KNPC). The state-owned enterprise not only strives to use state-of-the-art technology to produce primarily sulfur-free clean fuels. In the production process itself, energy efficiency and protecting the environment are likewise high on the agenda.

Text: Marcus Geigle Photography: KNPC, Ralf Baumgarten



## MUCH IS NEW IN THE EAST

Airlines such as Emirates, ETIHAD or Qatar Airways have become important players in transporting passengers and freight. The foundation of their success is the central geographic location of the Gulf States in a reoriented global economy.

The Gulf States lie at the midpoint among the economic centers of Europe, Russia, Africa, Asia and the Far East. Ancient trading centers have been revived due to the resource wealth of the region. Likewise, tourism has developed rapidly.

Regional industries will make an enormous contribution to the continued development of the Gulf States. Comprehensive state-supported development programs strongly encourage large oil and gas companies to make their high output more efficient, reliable and environmentally friendly.

Its roots reaching back to 1949, the Mina Al-Ahmadi refinery uses 40 reciprocating compressors in its production process. In the next few years they will be upgraded with respect to energy efficiency and environmental compatibility. In order to achieve ambitious emissions and efficiency targets, the operators of the KNPC refineries Mina Abdulla, Mina Al-Ahmadi and Shuaiba have called on external consultants, particularly when special expertise is needed.

KNPC relies on HOERBIGER's consulting expertise. A proprietary audit developed for these customer requirements will also help KNPC conserve energy while meeting ambitious emissions goals.

HOERBIGER is a dedicated innovation and technology leader in the field of reciprocating compressors. The Group continuously invests in basic research in order to understand the flow conditions inside the cylinders and at the valves, and this knowledge is applied to the development of increasingly efficient valves and controls. A further research area includes rings and packings to improve bearing assemblies and seals for piston rods.

HOERBIGER has applied this expertise, developed over decades, to the REE audit. At the customer's site, the audit team reviews whether and at what cost a compressor can be optimized with respect to reliability, efficiency and environmental soundness, in short REE. At the conclusion of the REE audit, HOERBIGER provides the customer with concrete suggestions for improvements. HOERBIGER and the customer then work out an implementation plan together.

This new service attracted great interest at KNPC. At the end of February 2013, the HOERBIGER REE team went to work in the Mina Al-Ahmadi refinery with a detailed analysis of each individual compressor, resulting in numerous ideas for improvement. The theoretical potential was then compared to the HOERBIGER database. Thus, the REE team could find a benchmark for each of the 40 reciprocating compressors in the Mina Al-Ahmadi refinery.

After initially spending four days on site, the REE team paid a subsequent visit a month later to present the audit results to the Maintenance Manager Tareq Y. Al-Saifan at KNPC's MAA refinery.

## PERSPECTIVE MAINTENANCE AND PROCESS MANAGEMENT

The experienced maintenance team led by Tareq Y. Al-Saifan was impressed. "We thought we knew everything about our compressors and how to employ them optimally. HOERBIGER's REE team impressively demonstrated how much more knowledge could be extracted from the operating data and inspection of every single machine. There was a lot to be



**"NOW WE HAVE 40 DETAILED ANALYSES INDICATING NUMEROUS IDEAS FOR SUSTAINABLE IMPROVEMENTS."**

Tareq Y. Al-Saifan



Maintenance Manager Tareq Y. Al-Saifan at KNPC's MAA refinery relies on HOERBIGER's consulting expertise.

- 1 The skyline of Kuwait City is reflective of the mood of change in the entire region.
- 2 One-on-one consultation takes place on-site at the compressor.
- 3 Improvement potential for environmental compatibility – the change management process that was initiated will minimize the burn-off of leakage gas.
- 4 KNPC's Maintenance team implements the suggestions from the audit as part of scheduled service work.
- 5 REE audit creates transparency even in complex environments, always bearing the plant as a whole in mind.

gained by including the requirements of process management in the audit." The result is impressive: "Now we have 40 detailed analyses indicating numerous ideas for sustainable improvements," Tareq Y. Al-Saifan states.

## REE IMPROVEMENTS MUST SUPPORT COMMERCIAL GOALS

KNPC managers themselves must determine the time lines for possible improvements. They can improve the system precisely at those points where the potential identified in the REE audit provides the greatest benefit.

For Tareq Y. Al-Saifan, the customer's freedom to interpret the results and apply the best-possible measure is equated with a high level of objectivity. "We need competent and innovative advisors who take into account the welfare of the entire plant. The HOERBIGER team showed us more about the compressors's performance and their capabilities during different operating states than all previous compressor experts who advised KNPC."

## A CONTRIBUTION TO THE GREATER WHOLE

By upgrading the refineries, KNPC intends to achieve more beyond improving the existing systems. The state-run group was founded in 1961 with the mission to make continuous contributions to the country's progress. In the medium and long term, this primarily means producing petroleum products in an energy-efficient and environmentally responsible manner.

Broken down into the individual production and organizational areas in the three KNPC refineries, the modernization and upgrade of the refineries are part of a major corporate vision for the future. In it, concrete targets are defined for how efficient, reliable and environmentally acceptable diesel fuel and gasoline production must become. This is the yardstick.

"We are oriented toward global best-practice solutions. This is also true of the organization as a whole," explains Tareq Y. Al-Saifan. "Structured change is a challenge, but the result will definitely bring us forward."

Every new initiative must adhere to the management of change process (MOC) program. Prior to engaging HOERBIGER, it had already been questioned whether optimizing the compressors would contribute to the overall goals within the previously defined change processes. Already prior to this preliminary review, it was quickly apparent that the REE audit would help in a structured way to support the desired improvements to reliability, efficiency and environmental soundness.



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## OIL ISN'T FREE OF CHARGE

Why is energy efficiency especially important in a refinery? Some might think that this issue doesn't play a role for petroleum producers along the Gulf, since they have more than enough oil.

As a result of the planned change and networking with world markets, KNPC is subject to the same price pressures as any other refinery operator. "We have to pay world market prices for the energy we consume in the production of diesel fuel and desulfured gasoline," Tareq Y. Al-Saifan explains. Pure extraction of crude oil costs between two and four dollars. However, the selling price for crude oil extracted by the Kuwait Oil Company (KOPC) is at the current market price of about 110 dollars. "For us, that is incentive enough to produce as efficiently as possible."



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- 1 The objective is to make compressors more reliable. The path: the REE audit.
- 2 Efficient advice for KNPC's maintenance specialists ensures greater reliability and efficiency of the entire refinery.
- 3 Up close – improvements are most apparent directly at the compressor. Teamwork in action between HOERBIGER and KNPC staff forms the basis of trust.

## KUWAIT'S ROAD INTO THE FUTURE

After Saudi Arabia, the Emirate of Kuwait with its Burgan oil field has the second-largest oil deposit in the world. The three refineries in that country process over a million barrels of crude oil daily.

In Kuwait, oil and gas will provide a few more years of prosperity. Will that be enough?

The state has instituted numerous modernization projects to make the country viable for the future. Kuwait does not want to fall behind compared to its neighbors, Dubai, the United Arab Emirates and Oman. A modern infrastructure and a clean environment should form the basis for "green tourism." Because of this, the greater part of the 125 million dollar investment program goes toward road improvement programs, rail transportation as well as repurposing the island of Falika off the coast of Kuwait in the Persian Gulf to become a green tourist oasis.

Concept for the Madinat al-Hareer (City of Silk), Kuwait, showing the Business Centre with the Burj Mubarak al Kabir (Tower of a Thousand and One Arabian Nights).

Investments are also being made in housing. In recent years prices have risen dramatically. Space is in short supply. The government is therefore providing help with extensive building projects. A symbol of this will be Madinat al-Hareer, the "City of Silk," with housing for 700,000 people. In 2030, the new Kuwaiti landmark will be the 1001-meter-tall skyscraper Burj Mubarak al-Kabir.



## PART

HOERBIGER's detailed consultancy with the REE audit is based on comprehensive knowledge of performance-defining components and characteristics of reciprocating compressors. These components include valves, rings and packings, oil scrapers as well as pistons and piston rods. Beyond the involvement of compressors in the complex processes of a refinery, the role compressors additionally play in control and remote maintenance systems is a major element in the identification of potential for improvement. The HOERBIGER REE audit enables customers in the oil, gas and process industry to enhance compressor reliability and efficiency. Frequently, in the process the efficiency of the entire plant is increased. With every optimization, environmental compatibility is increased.

## PART OF

The Kuwait National Petroleum Company (KNPC) is Kuwait's largest refinery operator. With its network of three refineries, Mina Abdulla, Mina Al-Ahmadi and Shuaiba, KNPC has the greatest refinery capacity in the Middle East. A million barrels of crude oil are refined there daily.

Nearly half the daily production volume comes from Mina Al-Ahmadi, the largest refinery. Over 80 percent of the fuel produced there is exported to Asia.

As a state-owned enterprise, KNPC is obligated to actively support current government programs to reduce emission, conserve energy and utilize environmentally friendly production processes.

## PARTNERSHIP

HOERBIGER has supported KNPC for over 15 years with its services for compressors. Previously, HOERBIGER's service facilities in Kuwait and Dubai supplied the KNPC refineries with spare parts. In addition, the components installed in the compressors were serviced at HOERBIGER facilities.

At KNPC, reciprocating compressors are primarily employed in the production of hydrogen required to desulfurize crude oil during refining.

In February 2013, a HOERBIGER consulting team conducted an REE audit at Mina Al-Ahmadi, the largest KNPC refinery. The audit covered a total of 40 compressors and showed the KNPC maintenance department improvement potential for each individual compressor. The focus was on reliability, energy efficiency and environmental compatibility, or REE.

KNPC has reviewed the REE audit recommendations and is considering their implementation through the MOC program. With their concrete improvements to energy efficiency, they should contribute to achieving the company's goals to save energy.

The REE audit concretely determined an energy consumption of 55 MW for all reciprocating compressors at the currently operated output. The compressors are designed for about 20 percent more capacity than the process requires; this is to compensate for production fluctuations as well as to cover future production increases using the existing equipment.

Using data obtained during the REE audit, HOERBIGER could clearly show that continuous reverse current regulation would result in a 10 percent reduction of the connected load.

# “HOERBIGER THINKS IN TERMS OF SOLUTIONS”

Tareq Y. Al-Saifan, Maintenance Manager at KNPC's MAA refinery, on the cooperation with the REE team



## ONE MIGHT ASSUME THAT YOU HAD ALMOST UNLIMITED FUNDS. WHY DOESN'T KNPC SIMPLY REPLACE THE OLD COMPRESSORS WITH NEW ONES?

Why should we consider total replacement of our compressors based on time in service? This is not just a question of money, but rather a matter of process reliability. We've adapted our compressors over years – in some cases over decades – to our processes and the specific requirements of our entire plant. I could also say that they have grown with our requirements and have become entwined with the entire facility.

Our topmost goal, therefore, is optimization of the existing 40 compressors, if possible.

Despite Kuwait's wealth of resources, we have to economize just like other companies the world over. We can only invest what we earn with reasonable margins.

Profits on petroleum products are not as high as everyone thinks. We buy crude oil at typical market prices, which represents a significant investment. Refining has to be efficient and cost effective. We have teams in the refinery that constantly look into the processes and whether energy is being wasted and where correspondingly attractive savings potential exists. If we can save 10 percent with the REE audit, then that is a considerable benefit.

## WHAT ARE YOUR EXPECTATIONS OF HOERBIGER IN THE FUTURE?

Simply this: mechanical availability. Just like the entire plant, each installed component has to be available for operation at all times. At Mina Al-Ahmadi there is no alternative.

Our task is to reduce unscheduled stoppage time to zero. As a partner of KNPC, HOERBIGER has taken our engagement to heart: optimized production cycles and no idle time. The objective is higher quality at lower cost. HOERBIGER showed us where we can optimize. The resulting savings can be invested in modernization of our plants, in our personnel and in infrastructure improvements.

## WHAT DID YOU EXPECT OF THE REE AUDIT?

Harsha Rao, our contact person at HOERBIGER, suggested an REE audit. When I heard about this suggestion for the first time, I thought it was very interesting that our service provider for reciprocating compressors, HOERBIGER, had an eye on the big picture of our plant with its REE approach – especially with respect to issues important to us in maintenance such as reliability, efficiency and environmental soundness. For me, the REE audit was an opportunity to examine whether the path to identify and implement improvements within our corporate-wide PIR (Procedure First) change management program is actually helpful.

## WAS THE PATH HELPFUL?

Unequivocally yes! HOERBIGER was provided with the technical design of the compressors and their integration into the plant as a whole. I was astonished by the knowledge Nikolaus Lubega and his team had above and beyond compressors. It was really impressive how focused the detailed analysis of the compressors was carried out. For example, based on this assessment far-reaching suggestions for increasing energy efficiency were made. It became clear to me why HOERBIGER is so successful. HOERBIGER thinks in terms of solutions, as we have so excellently experienced with the REE team.