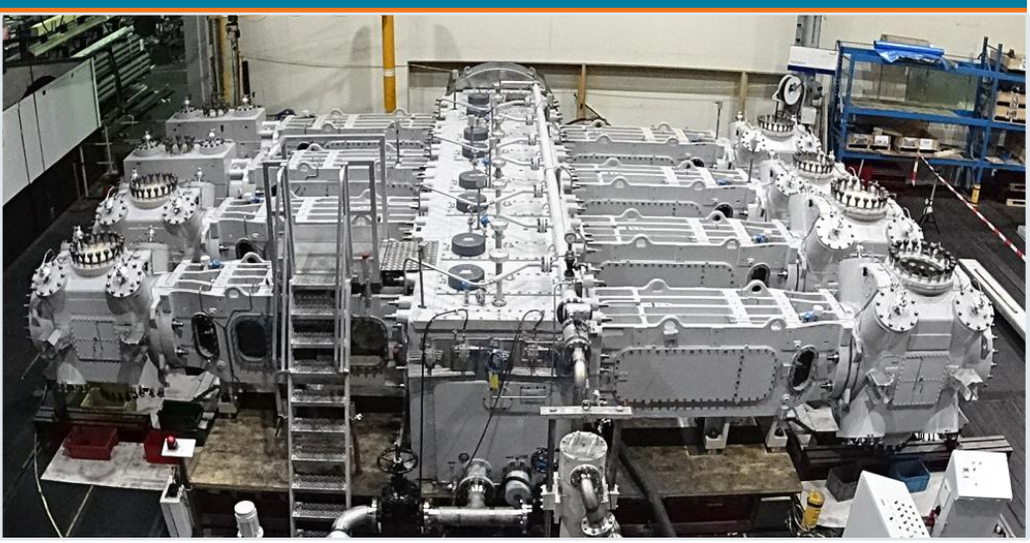
Whitepaper

Building the world's biggest reciprocating compressor



"Howden has designed compressors that go beyond all known engineering specs",

Marc van Heyningen, Managing Director of Fluor NL

Kuwait National Petroleum Company (KNPC) is integrating and upgrading two of its existing refineries. For the modernized refinery complex Howden Thomassen Compressors (HTC) has been awarded by the engineering firm Fluor to build the largest API reciprocating compressors ever constructed for the oil, gas, refining and (petro)chemical industry.

The first Thomassen C-85 reciprocating compressor with eight cylinders and a capacity of 16.6 MW was delivered within the challenging one-year deadline. The compressor is one in a series of six, the last of which will be delivered six months later than the first. The building of these compressors are a key milestone for a new generation of compressors that not only comply, but exceed the current API 618 (American Petroleum Institute) specifications and Shell DEPs (Design Engineering Practices).

Howden took the initiative to opt for six compressors with eight cylinders each instead of the initial seven compressors requested for KNPC. This was with the full backing of contractor Fluor.

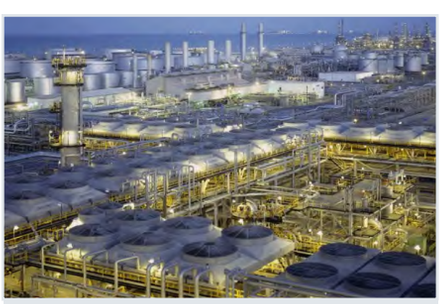
Marc van Heyningen, Managing Director of Fluor NL:

"Howden go further than just supplying the standard regulation compressor models. They have developed compressors beyond all known engineering specs. It has been a tremendous undertaking. We are very excited about the complex mega equipment delivered by Howden. Their top notch expertise and the fact that the equipment is Made in Holland is something to be proud of."

Out-of-the-box thinking

Before arriving at the choice of six rather than seven compressors, various options with six and seven compressors and six to eight cylinders were examined by Howden and Fluor in terms of their feasibility and suitability for the project.

Niek Albers, Manager of Technology HTC explains why the final decision of opting for six compressors with eight cylinders was taken: "Although a combination of six reciprocating compressors with this capacity had never been realized, Howden already had the design for an eight-cylinder compressor frame on paper, and we had experience in integrating larger numbers of parallel compressors. The creation of the frame for an eight-cylinder compressor is an innovation that began some time ago at Howden. Making the final choice to go with six compressors with eight cylinders was based on attempting to achieve the highest efficiency and greatest flexibility in regulating capacity."



KNPC Refinery

Kuwait National Petroleum Company:

KNPC currently owns and operates three refineries in the State of Kuwait; Mina Al Ahmadi (MAA), Mina Abdullah (MAB) and Shuaiba (SHU) refineries, all located along the coastal zone south of Kuwait City, and within approximately ten kilometers from each other. As part of the Clean Fuels Project, KNPC plans the retirement of the processing facilities at Shuaiba Refinery, and a major upgrade/expansion of the MAA and MAB refineries to integrate KNPC's Refining System into one Refining Complex with Full Conversion operation with the highest Light Ends Products Yields and nil Fuel Oil production.

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Robust choices

Niek also outlines the robust and thorough planning that went into this highly complex project: "Since the C-85 compressor with eight cylinders had never previously been built, we made detailed calculations prior to the award of the project by Fluor. For these compressors, specific attention was placed on the preliminary phase, investigating aspects such as torsional vibrations and pulsations. This enabled Howden, in collaboration with Fluor, to identify the critical issues early on and come up with concrete solutions; guaranteeing the reliability of the compression system.

That reliability is an absolute prerequisite for a project where system downtime can cost millionsof dollars. This preliminary thoroughness and collaboration with Fluor meant we could make robust choices concerning the design, such as the optimum load per machine, and creating a flexible but easily adjustable capacity for each of the different compressors." Given the considerable number of possible combinations of operating compressors, regulating the capacity is a complex matter. In theory there are around ten thousand possible combinations to regulate capacity: all five machines in operation (with one machine on standby) can be adjusted to loads of 0%, 25%, 50%, 75% or 100%.

Reliability is an absolute prerequisite for a project where system downtime can cost millions of dollars

Integrated compression system

The scale of the compression system is unprecedented. The six compressors together are responsible for compressing hydrogen for virtually all of the hydrogen suppliers and consumers within the refinery. There are now no longer any physical barriers separating the many hydrogen consumers within the facility. The compressors receive hydrogen from the world's largest hydrogen production facility as well as recovered hydrogen from the production units. In the world's largest single hydrogen compression facility, the hydrogen is compressed for use as makeup hydrogen for various desulphurization, hydrocracking and hydrotreating units.

Henk Hoven, Managing Director of Howden Thomassen Compressors:

"It is technically an excellent product made by an outstanding team. Fluor was very much a part of the design and building process in which we were engaged. Also, they brought in knowledge about the integration of the compressors into the refinery processes. We were able to jointly create an integrated system with an optimal performance which is more than the sum of its parts. It will result in a smaller footprint and in significantly lower procurement, installation and maintenance costs for KNPC and Fluor. Only through ongoing innovation in compression engineering, system integration and areas of application, together with our customers, can we guarantee the best possible solution time and again."

Fluor:

Fluor is one of the world's leading, stock-listed companies for engineering, procurement, construction, maintenance and project management. Fluor has been active in the Netherlands for over 55 years and combines international strength with local focus for customers all over the world. Since its foundation in the Netherlands, Fluor has carried out projects in Europe, the Middle East and Africa. Moreover, Fluor NL is an established name in the energy and chemicals markets of these regions.

Howden:

Howden Thomassen Compressors is one of the world's leading manufacturers of reciprocating compressors. With over a century of experience in compression solutions, we supply to major refineries, leading oil and gas industries, petrochemical companies and other industrial organizations. We have developed several highly innovative solutions for customers focused on optimizing the availability, reliability and total costs of ownership of their compressors.

- Howden Thomassen Compressors is well known for the manufacturing of heavy duty Thomassen reciprocating compressors and auxiliary systems compliant to API618, as well as the supply of multistage turbo compressors, re-aeros and retrofits compliant to API 617.
- Our field and support services include the installing and commissioning of new equipment the servicing of both Howden's installed base and of non-Howden equipment. These services are supported by a 2nd and 3rd Line Technical Support Team and a Service Repair Shop in our 'Centre of Excellence' in The Netherlands.
- Our services are complemented by our compressor operation training courses offered in Rheden, the Netherlands, and also on customer sites.