Arctic resource recovery tests
materials technology
The last time Stainless Steel World magazine spoke with material specialist Mr. Babak Bahar, he was working at Aker Solutions. Since then he has moved to Kvaerner headquarters in Oslo, Norway, to fulfil a similar role there and joined the Duplex Seminar & Summit Steering Committee. We caught up with Mr. Bahar to find out more about what he is currently involved in and what materials and corrosion related challenges they try to solve in the arctic environment.

By John Butterfield and Gillian Gane

Photo: Kvaerner
“At Kvaerner Engineering our focus is mainly offshore, on top side construction of all aspects of oil and gas platforms including drilling, process, risers, and living platforms,” Mr. Bahar tells us, adding: “As a material specialist my role concentrates on material and corrosion related issues in the design and construction of the platforms. We have to keep abreast of new standards, materials and technologies to be able to provide information regarding material selection, corrosion protection and welding issues as required.”

He explains that the main difference between what he was doing at Aker Solutions and his current role is that Aker Solutions is a very big company with different business areas for new build, inspection and maintenance whereas Kvaerner mainly focuses on new builds. “However this does not mean that we do not consider the maintenance issues in design. For some time Kvaerner have worked on developing a cost efficient, standardised wellhead platform concept called “Subsea On a Stick - SOS™.” The new wellhead platforms could both increase recovery and utilise the new generations of jack-up drilling rigs, as well as reducing development and maintenance costs. The concept is focused on minimization of facilities, equipment and costs down to water depths of 492 feet (150 m) and may be a cost effective solution compared to a conventional subsea tie-back solution.”

On a day to day basis material engineers within Kvaerner Engineering could be contacted by different disciplines regarding a number of issues. “This can include things such as material selection for a specific offshore platform, reviewing certificates, reviewing material selection set by an earlier supplier during the FEED phase to ensure it covers corrosion protection and welding issues, amongst others,” Mr. Bahar says, continuing, “Not forgetting, of course, development of new products. We have some activities focusing on the Arctic environment which presents different factors to platforms, for instance. The recent reported estimates have shown that this area may contain up to 13 percent of the world’s undiscovered hydrocarbon reserves, and up to 30 percent of the worlds unexplored natural gas, most of this offshore. Ernst & Young reported 2013 that the total estimate of the potential Arctic oil and gas resources is 412 billion barrel of oil equivalent, where the Norwegian Barents Sea is estimated to comprise 12% of these reserves. It is also estimated that Russia holds more than half of the total oil and gas resources in the Arctic region. Even having in the mind the fact that hydrocarbon exploration and production in the Arctic region is considered technically challenging; a combination of advanced technologies and relatively stable high oil prices have led to a surge of interest in petroleum exploration in the Arctic. There are, however, numerous environmental challenges connected..."
to drilling and operating in the Arctic that must be considered, among them icing."

The Arctic challenge
"Compared to the North Sea the air temperature in the Arctic is much lower and ice accretion may hinder the operation of many critical systems," explains Mr. Bahar. "Ice freezes on instruments, communication equipment, ventilation, wiring, evacuation routes and the helicopter pad which can affect the overall safety of the platform. Arctic air temperatures can easily drop down to below -80°C and a relatively thick and adhesive ice layer can develop on the coatings, which can have a potentially disastrous impact. Icing is caused via sea spray, under-cooled rain, snow and also atmospheric icing. The use of heat tracing has proved to be an efficient method against icing, but also results in huge electricity demand and cost over the platform life time. Another competitive method is the use of coatings, which lowers the adhesion forces between ice and steel surface. There is a flurry of activity within the research and development of ice-phobic coatings and we believe that there is the potential to apply this on offshore platforms. The main advantages of coatings are that they can easily be applied over any surface and that they do not require power."

Stainless steels and offshore
Have things changed in the last few years in terms of the volumes of duplex and super duplex used on offshore platforms? Mr. Bahar believes so. "Oil and gas needs to be processed as much as possible on the platform before transportation, to get the highest possible value for petrochemical products. This often results in higher temperatures, higher pressures and more aggressive corrosive processes, plus the offshore environment is itself corrosive due to the saline atmosphere. Duplex stainless steels in general are very good choices in a marine offshore environment. Other materials may be cheaper but if we do use another material we may have to take into account the cost of painting/repainting when estimating the cost at the outset, including the paint and labour, sandblasting old paint during maintenance, the cost of scaffolding and isolation or shutdown of the process concerned whilst this is carried out. It is better to consider using a more corrosion resistant, durable material at the beginning to comply with the standards. This keeps things simple."

Oil and gas production going further north
Now that companies are increasingly turning to colder regions in search of oil and gas, the demands on materials properties in cold temperature and corrosion protection has become a higher priority. Mr. Bahar says; "based on an increasing demand for energy in the world, we have to go to more extreme environments, so better technology and adopted materials are required in order to maintain production at a reasonable price."

So, does it depend on the type of material used, as what actions will be required? "This should be clearly outlined in the standards," explains Mr. Bahar. They should specify, for example, what process systems should be made of steel and what should be made of stainless steel. Low design temperatures, large temperature variations and large deformations are additional issues which shall be carefully considered in the materials selection process. But, not only do the metallic materials need to withstand the mentioned challenges, also the coatings and other non-metallic materials must be able to cope with these extremes."

Structural steels can be prone to brittle fracture at low temperatures if appropriate actions are not taken. The lowest ambient temperature on the Norwegian continental shelf is about -20°C. In the Arctic regions, minimum ambient temperatures lower than -50°C must be expected (year round subzero temperature with wind velocities up
The Subsea On a Stick - SOS™ concept is focused on minimizing facilities, equipment and costs down to water depths of 492 feet (150 m). Photo: Kvaerner