

# Piping engineering for complex oil, gas, and petrochemical projects

## Interview with Mahsa Bakherad, Piping Lead Engineer with Orascom E&C USA Inc.

Mahsa Bakherad began her career in Iran as a Piping Engineer through an internship program. Graduating with a Bachelor of Science degree in Metallurgy Engineering and earning a Masters in Materials Engineering – Corrosion & Protection, Mahsa has gained over a decade of experience working in oil & gas and petrochemical plants. Stainless Steel World News had the opportunity to meet with Mahsa in Houston, Texas to learn more about her experiences working in Piping Engineering and the use of stainless steel and corrosion resistant alloys in her current projects.

By Sarah Bradley

### An engineering background

“Iran is one of the biggest countries in the oil and gas industry. When I was a student, my brother was working as a mechanical engineer and he introduced me to many different types of engineering work in the industry. I found piping engineering to fit well with my interests and also my studies, because having a background in Material Engineering is very important in selecting materials for piping and valves,” explained Mahsa. “Within

industry, piping is a system of pipes used to convey fluids such as liquids and gases from one location to another. The engineering discipline of piping design studies the efficient transport of fluid. Generally, industrial piping engineering involves three major subfields: Piping Materials, Piping Design, and Stress Analysis. The knowledge of corrosion and protection is needed for determining how to protect pipeline/ piping in corrosive environments.”

Mahsa has spent over a decade working for five different companies on eight different big projects. Arriving in the United States in 2014 as a permanent resident, Mahsa began working as Piping Lead Engineer for Orascom E&C based in Houston, Texas.

### Current projects

Orascom Construction Limited is a leading global engineering and construction contractor primarily focused on infrastructure, industrial, and high-end commercial projects in the Middle East, North Africa, the United States, and the Pacific Rim for public and private clients. Orascom E&C USA Inc., is Orascom Construction’s wholly owned engineering and construction subsidiary based in the United States. With its Head Office located in Mclean, Virginia, Orascom E&C is specialized in the construction of large industrial facilities including two new projects: a Debottlenecking facility in Beaumont, TX that will increase annual methanol production capacity by approximately 182,500 metric tons and annual ammonia production capacity by approximately 40,000 metric tons; and a USD 1.5 billion natural gas-based fertilizer production facility in Wever, Iowa that will produce 1.7 to 2.2 million tons per year of ammonia, urea, urea ammonium nitrate, and diesel exhaust fluid. This fertilizer plant is the first world scale facility of its kind built in the U.S. in 25 years.

Mahsa is currently involved in the Nat-Gas Methanol plant in Beaumont. The methanol production plant is being constructed on a 514 acre plot of land located adjacent to the existing integrated ammonia and methanol production complex. The projects form the first phase of the larger gas-to-gasoline (GtG) plant proposed by NatGasoline. The second phase of the GtG plant involves the construction of a 22,000-barrel per day (bpd) motor-grade methanol to gasoline (MtG) production unit using the refined methanol either from the proposed new methanol production unit or other sources as



Ms. Mahsa Bakherad is Piping Lead Engineer with Orascom E&C USA Inc.

feedstock. Air Liquid was contracted to supply oxygen to the plant and will also construct a new air separation unit (ASU) at the site to produce oxygen, nitrogen, and argon.

“EPC projects have three parts; engineering, procurement, and construction. This project includes all three parts. The engineering part, which is detail design of our plant, is assigned to our subcontractor Air Liquide in Poland. Procurement and construction is handled the Orascom team. In my role, I am interfacing between the different vendors and subcontractors in the piping discipline. I check and review all of the piping documents and would solve any issues that come up related to piping,” said Mahsa. “For example, AL engineering team will issue the

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valve data sheet for us and during the purchasing process, needs to review vendor deviations. I would review the documents and see if I can alter some requirements or review the technical offer from the vendor to make sure the deviation is acceptable or not. Then I would negotiate with the vendors, procurement, and the design company to decide which is the best option available."

In her current role Mahsa is supervising all piping deliverables by the engineering contractor (Air Liquide) including 3D model, specifications, line list, ISOs, MTOs, piping plot plan layout, and more. Resolving any issues related to piping materials, specifications, fabrication, and field construction, she enjoys the diversity and challenges her role brings.

"Within industry, piping is a system of pipes used to convey fluids (liquids and gases) from one location to another. The engineering discipline of piping design studies the efficient transport of fluid. Piping Engineering is wide and it can be challenging to know about all the components like pipes, valves, fittings, flanges, gaskets—how are the components used and what are the important factors to take into consideration? What materials should be used in which applications? What are the important industry standards used for piping components? There are many different components so you should know all this information for each of them," Mahsa revealed. "I like to learn new things and there are lots of matters related to piping

and thermal-fatigue strength; oxidation resistance; and excellent weldability and brazeability are the properties of Inconel alloy 625. However, in my previous projects we used duplex stainless steel against general corrosion in CO<sub>2</sub> or water content environments. Also, we used corrosion resistant alloys with a high Pitting Resistance such as 25Cr Super Duplex or CRA 2550E when the chloride content exceeded 1,000 ppm or oxygen content exceeds 10 ppb," she said. "In addition, I have experience in using alloys with nickel content greater than 42%, such as CRA 2550E which is considered immune to SCC from chlorides. Chlorides in the presence of tensile stresses may also lead to Stress Corrosion Cracking (SCC) at elevated temperatures."

Working with some of the higher grade alloys, though ideal for the application can also bring some challenges. "Sometimes it is more expensive or we cannot find it in a short period of time. Especially with Inconel we need stronger procurement process and we often need the material in reasonable time and cost. It is a big problem if you need large bore materials," she described. In the most instances of oil, gas, or petrochemical industries there are sour service conditions. Environments with partial pressure of H<sub>2</sub>S greater than 0.05 psi are considered "sour" and cracking can only be avoided through the proper selection of materials.

As she further explained: "The potential for an increase in H<sub>2</sub>S content over the life of the well should be

vendor list going forward," Mahsa explained.

### Feelings on the future

Mahsa believes that the industry has changed significantly in recent times and that ongoing technological advancements and the development of new software will continue to change the game. Innovation in 3D modeling, stress analysis software, and material management programs are all ways that her role specifically has been positively impacted by technological advancements. Mahsa is also excited about the new possibilities these

changes will bring to the oil & gas and petrochemical industry and the piping engineering field.

"My current project is the most interesting one for me. It is a big chance for me to work on this huge project and I learned a lot while working closely with European companies like our design firm, and many U.S. companies and subcontractors," concluded Mahsa. "Now I have a big picture of piping and I am involved with all parts of Engineering, Procurement, and Construction from the beginning of the project until it will be completed."



Mahsa has spent over a decade working for five different companies on eight different big projects. Photo: Business Wire

**"In my current project we are using Inconel 625 for its high strength, excellent fabricability including joining and outstanding corrosion resistance"**

that I can learn everyday which can be about corrosion, welding, inspection, and more. It is so broad that if you want to change your area of focus, there are plenty of opportunities. It is good for me because I do not get bored at all in the piping field. It makes me feel alive. Everyday I can face new challenges to solve."

Though Mahsa thrives on the challenges, that does not mean that her role does not include some difficulties. Often time and cost of projects can bring new challenges of their own.

"Sometimes you might have to search out ways to work more affordably and in reasonable time. It can make some decisions difficult. It can also make it challenging to find the best product for the application while meeting these parameters, but you never compromise quality and safety," said Mahsa.

### Selecting compatible materials

In the NatGas project, several types of stainless steel materials and corrosion resistant alloys are used such as ASTM A 312 GR.TP304, A 312 GR.TP316, ASTM A 358 GR.304. Mahsa explained that she usually selects the best compatible material based on chemical composition of service fluids, and conditions such as pressure, temperature, and environment. She revealed that corrosion and its mechanism is different in various environments such as in environments involving CO<sub>2</sub>, H<sub>2</sub>S Cl-, O<sub>2</sub>, H<sub>2</sub>, etc.

"In my current project we use Inconel 625. It is used for its high strength, excellent fabricability including joining and outstanding corrosion resistance. Service temperatures range from cryogenic to 1800°F (982°C). High tensile, creep, and rupture strength; outstanding fatigue

considered. NACE MR0175/ISO 15156 serves as the industry guideline for selection of materials for sour service. Material properties contributing to EAC (environmentally assisted cracking) resistance include composition, microstructure, processing history, and hardness."

### Procurement

In the piping discipline, Mahsa's team prepare MTOs and then using an approved vendor list the procurement team select three to four vendors to give their technical offers. Piping team check the vendor offers technically, verify their product catalogs, certification test report, and prepare technical bid evaluations for piping components based on the vendor offers. Finally, the procurement team make a final decision based on price.

While many of the components being specified are commonly used in similar projects and are fairly easy to obtain through many vendors on the company's approved vendors list, Mahsa explained that some specialty products and components that are more customized might not be as readily available as commodity products.

"Sometimes for special components we may have to purchase some materials from a new vendor. In this situation, the procurement team usually search and find new vendors that are able to provide the required components and send their catalogues for us and the client to approve. We verify that they can provide the exact product we need, review their certifications and the required procurement team help narrow down the choices based on price and time scheduling. After a vendor has been approved, it can be added to the

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