Eric Jas, Atteris Pty Ltd., Australia, shares a unique project initiated in Perth, Western Australia in 2011, concerning subsea pipeline engineering competencies.

Elevating standards down under

In a recent edition of *World Pipelines* (December 2015), the importance of mentoring was emphasised. When properly practised, mentoring significantly contributes to increased competency levels of employed staff. For competency levels in a certain industry field to be understood and assessed, a competency framework that describes them in sufficient detail is required.

The project

A recent project in Australia comprised the formulation of the competencies needed for a pipeline engineer in the offshore industry, and their compilation into a set of standards. The work includes 57 different competencies in 12 competency areas (Table 1). They have been written by experienced engineering professionals in the offshore pipeline industry from a range of different companies.

It would seem strange that such competency standards are written now; six decades after the first offshore hydrocarbon pipelines became operational and after many thousands of kilometres have been installed. Offshore pipelines usually contain high-pressure hydrocarbon products or other hazardous by-products, and operate in a dynamic marine environment. They also traverse challenging terrain, environmentally sensitive areas and, where they make landfall, often populated areas. Codes and standards are one way to ensure the required high integrity of pipelines. However, these documents still require the user to have a minimum level of competency. The Australian standard for gas and liquid petroleum pipelines (AS 2885) requires competent persons to make decisions or provide approval in a range of situations. Licensees and pipeline owners must be sure that these engineers are competent to do so in each case.

Some companies, in particular several oil and gas operators, have developed their own engineering competency standards for their internal use for the range of disciplines they engage in, including offshore pipeline engineering.

The significance of the recently completed project is that it was managed by a national industry body (APGA[1]) in close collaboration with a national engineering institute, Engineers Australia. The competency standards will be included within the National Engineering Registration framework, such that engineers working in this industry in Australia can achieve chartered professional engineer status with oil and gas pipeline engineering as a special area of practice.

The project is a subset of a larger campaign, which was originated in Australia in 2008 by the APGA. The project originally focused on onshore pipeline engineering skillsets. The need to develop competency standards for onshore pipeline engineers originated from skills shortage caused by a significant increase of pipeline work in combination with the retirement of a relatively large group of veteran pipeline engineers. This is also relevant for the offshore industry.

Those involved

A noteworthy aspect of the project is that all of it was undertaken in-kind by experienced senior engineering professionals. Senior engineering and management staff from the following organisations contributed to the programme:

- APGA co-ordinators Chris Harvey and Karen Polglaze, who are involved with both the onshore and offshore pipeline engineering competency projects; Chris and Karen have provided direction and support to ensure full compatibility between the onshore and the offshore competency programmes. This compatibility is essential from many perspectives (see later in this article).
- Several principal offshore oil and gas operators based in Perth, Western Australia have provided senior engineering and management staff to write and review competencies.
- Atteris Pty Ltd (the Perth based pipelines and subsea engineering consultancy) acted as the co-ordinator and project manager of the offshore pipeline engineering competencies project, and has been a major contributor to writing them.
- A number of engineering consultancies contributed to the writing of the competencies; the full listing of these are: ARV (also a reference group member), 2H Offshore, Cube Offshore, CCE, SEA, S2V and IntecSea.
- A number of individual industry experts volunteered to write several specialist competencies.
- A panel of 15 global experts who are actively working in the offshore pipeline industry have peer reviewed all competencies.

The benefits

Offshore (or subsea) pipeline engineers are in most cases persons with an engineering degree in a general area of practice for professional engineers. These are in most cases either mechanical, civil or chemical engineering. A competent offshore pipeline engineer will need to master a specific set of engineering competencies, which comprise a mix of competencies from these general areas of practice supplemented with a large number of offshore and pipeline specific competencies acquired through training, mentoring and experience.

The programme has many benefits. For instance, with this standard, companies who employ offshore pipeline engineers can:

- Determine if a pipeline engineer is competent for a particular role or activity.
- Improve the clarity of job descriptions.
- Undertake a competency gap analysis – at industry, company, department and individual level.
- Use the standards to assist in the recruitment of new engineering staff.
- Create pipeline engineer development plans.
- Develop pipeline engineer training programmes.
- Manage team capability.
- Provide tools for personal career planning.

The ‘early 2000’ boom

Australia experienced a significant boom in the pipeline industry between 2005 and 2015. The boom was predominantly fueled by the development of a number of very large LNG projects. A large influx of engineers into the pipeline industry was required to meet the demand for energy in Asia. It resulted in Australia becoming one of the most attractive locations to work due to the choice of work and high remuneration levels. However, it also resulted in dilution of the industry’s competency level. With no common structure in this area, other than a mixed range of company-specific competency requirements, adequate training and mentoring of young pipeline engineers was hindered. To complicate matters, the output of the engineering work was required at a high pace. The compromising effect on the

Table 1. The full listing of offshore pipeline engineering competencies	
Competency areas	**Competencies**
General engineering	Engineering degree in a relevant discipline
	Offshore pipeline engineering fundamentals
	Technical governance
	Industry background and knowledge
Flow assurance and process engineering	Flow assurance fundamentals
	Process engineering fundamentals
Materials, welding and corrosion	Corrosion control and materials engineering fundamentals
	Internal corrosion and control
	External corrosion and control
	Materials selection and engineering
	Welding processes and design considerations
	Erosion mechanisms and control
Safety management and risk assessment	Risk management fundamentals
	Safety management fundamentals
	External impact quantitative risk assessment
	Pipeline safety cases
Environment and heritage	Environment and heritage – identification and assessment of issues
	Environment and heritage – management and control
	Legislative processes (environment, heritage and tenure)
Design of offshore pipeline systems	Offshore pipeline system fundamentals
	Onshore pipeline system fundamentals (interface with offshore)
	Geotechnical engineering fundamentals
	Metocean data fundamentals
	Route selection and alignment sheet engineering
	Mechanical design of rigid offshore pipeline systems
	Pipeline stabilisation design
	Pipeline crossings design
	Pipeline shore crossing design
	Pipeline buckling and walking
	Procurement/construction/design specification preparation
	Instrumentation and controls
	Pipeline external impact protection design
	Flexible flowlines
Design of pipeline related structures	Design of related structures fundamentals
	Interfacing with subsea structures
	Pipeline fittings (tees, wyes)
Design of risers (rigid, flexible, SCRs)	Design of risers fundamentals
	Riser system design
Construction engineering and management	Pipeline construction fundamentals
	Pipeline installation engineering and analysis
	Construction vessels and equipment
	Pipeline tie-ins (spools, connections, hot tap)
	Riser installation
Offshore pipeline project management	Pipeline project management fundamentals
	Commercial aspects of pipeline projects
	Project execution planning
	Contracting strategy and management
Pre-commissioning and commissioning	Offshore pipeline pre-commissioning
	Offshore pipeline commissioning
Asset management and pipeline operations	Asset management and pipeline operations fundamentals
	Risk based integrity management process
	Inspection and monitoring systems
	Fitness for service and engineering assessments
	Pipeline repair and recommissioning
	Design and operating conditions (MAOP, safety systems, etc.)
	Operational and intelligent pigging
	Decommissioning

competency level of the engineering population across the industry was consequentially high.

The onshore - offshore gap

A traditionally cumbersome issue also exists with an offshore pipeline which travels to shore and then continues as an onshore pipeline. Firstly, there is the change in design code at the shore crossing. This is not only an issue in Australia; it occurs in many other countries which have a specific national design code for hydrocarbon pipelines. In many cases there is inconsistency between the two codes. Secondly, offshore and onshore pipeline engineers operate in two distinctly different industries with most pipeline operators, engineering consultancies and construction contractors operational in one or the other, and rarely in both. A single pipeline system may travel from offshore to onshore; the design, construction and operational methods can be vastly different. Alienation between both industries has unfortunately also been witnessed in many cases.

It is at the shore crossing where both industries meet. Most pipeline engineers feel comfortable in their own space (dry land, i.e. above the high water mark, or seabed covered by at least 5 - 10 m of water column for onshore and offshore pipeline engineers respectively). The zone in between these two (the shore crossing) is often either incorrectly designed or under-engineered by the time the construction contractors are engaged. Depending on the level of expertise of the contractors, and the ability to effectively collaborate (between onshore and offshore), significant complications are often experienced during the construction and operational phase of a pipeline at this location (Figure 1). For this reason it is essential that the pipeline engineering competencies, which have been developed in parallel for onshore and offshore remain fully compatible so that interfacing the engineering between them can be performed effectively and efficiently.

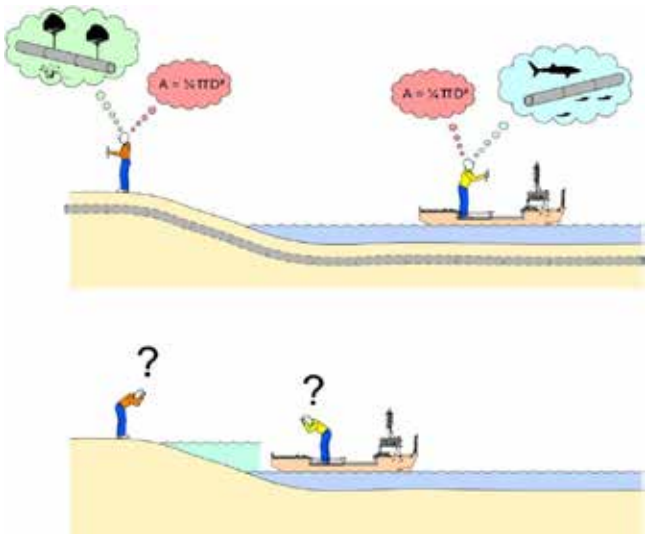

Figure 1. The onshore - offshore gap.

The industry in Australia is currently resolving this issue. Work is being undertaken to update both the national and international pipeline standards to improve engineering for the shore crossing.

Subsea and offshore pipelines

A third competency standards project is being developed for subsea engineering (subsea equipment excluding pipelines, but with a strong interface with offshore pipelines). This project is being performed through a JIP involving – amongst others – the Society of Underwater Technology (SUT), under a Memorandum of Understanding (MoU), which has been signed between the APGA and the SUT. Each of the three standards (onshore pipelines, offshore pipelines and subsea) can then co-exist side by side, providing a comprehensive and complementary set of competency standards for the oil and gas industry.

Each competency has been assessed to be either 'core', 'elective' or 'specialist'. It is not expected that a competent offshore pipeline engineer needs to master all of the competencies. This recognises that, even within the industry, there are distinct skillsets depending on experience within the design, construction or operations of an offshore pipeline.

The standard also provides information on:

- The delineation between the onshore pipelines, offshore pipelines and subsea competency standards.
- A listing of all relevant offshore pipeline acronyms and terminology.
- The process to become registered as a chartered engineer in the special area of practice of oil and gas pipelines engineering in Australia.

Summary

The importance of this project should not be underestimated. It will provide greater clarity to engineers entering the industry and what is expected from them. Employers will be able to develop staff in a more structured manner. Engineers are therefore encouraged to apply to register in the special area of practice.

The ultimate objective of the project is to make the competency standards for offshore pipeline engineering available to the global offshore pipeline industry as a global standard. It is expected that this would truly enhance standards in the industry.

Notes

1. The Australian Pipelines and Gas Association Ltd (APGA) is the peak body representing Australasia's pipeline infrastructure (onshore and offshore), with a focus on gas transmission, but also including transportation of other products, such as oil, water, slurry and CO_2. Its members include constructors, owners, operators, advisers, engineering companies and suppliers of pipeline products and services.
2. Engineering Guideline for Pipeline Shoreline and Waterway Crossings (Energy Pipelines Co-operative Research Centre – EPCRC, co-funded by Woodside Energy and Chevron Australia). The EPCRC provides research and education to support and benefit the energy pipelines industry in Australia. Through the APGA Research and Standards Committee, EPCRC is a member of an International Tripartite with the Pipeline Research Council International (PRCI) and the European Pipeline Research Group (EPRG).