EXPANDING APIA'S PIPELINE ENGINEER TRAINING PROGRAM -OFFSHORE COMPETENCIES

Eric Jas
Managing Director
Atteris Pty Ltd

Chris Harvey
Principal
Chris Harvey Consulting

September 2013

Expanding APIA's Pipeline Engineer Training Program – Offshore Competencies

Abstract

In 2010 APIA published its Pipeline Engineer Competency Standards, which set out the definitions of competency across the breadth of pipeline engineering roles. It identified 230 Competencies and wrote up 91 of these in detail. However, these Competency Standards, while they left a place marker for offshore pipeline engineering, were focused on onshore pipelines reflecting the bulk of APIA's membership. Since then there has been increasing interest and involvement in APIA by the offshore industry, so much so that a group of key offshore participants have banded together to identify the competencies needed for offshore pipeline engineering and draft them into a set of Competency Standards for offshore pipeline engineers.

What is noticeable is that while the competencies required by offshore pipeline engineers parallel those for onshore in many respects, in many more respects they are different, because many of the issues to be managed in the offshore setting differ greatly from those for onshore pipelines.

This paper outlines the background, and the process for developing the offshore Competency Standards, including the battery limits for offshore pipelines and the interface with onshore pipelines and offshore facilities, an overview of the offshore Competency Areas, the aspects where offshore and onshore pipelines are either similar or different and the state of progress of development of the Offshore Competency Standards.

Scope Definition

This paper only considers rigid and flexible pipelines used to transport hydrocarbons. Not included are offshore pipelines which transport products such as water, waste water or slurry.

Background

The need for a (onshore) pipeline engineer training program was primarily driven by a perceived shortage (or emerging shortage) of (onshore) pipeline engineers.[1] The shortage of pipeline engineers also applies to the offshore industry in Australia.

The current boom in the pipeline industry has been fuelled by the development of an unprecedented large number of LNG projects, driven by the demand from the energy-hungry regional Asian markets. Today there are 32 LNG plants operational worldwide, of which three in Australia (two in Karratha WA and one in Darwin NT).Out of the 11 new LNG plants under construction globally, seven are being built in Australia.[2] This will increase Australia's share in the number of LNG plants from 10% today to approximately 25% towards the end of this decade.

The total number of offshore pipeline kilometres in Australia has more than trebled from less than 1,000 km in 2003 to more than 3,000 km in 2013. It is expected that by 2017 Australia will have approximately 5,000 km of offshore pipelines in operation.

The vast majority of the offshore pipelines in Australia are designed in Perth WA. The offshore pipeline engineering boom, which has affected this relatively small city during the last decade, can therefore be classified as very local.

There are several major downsides associated with such a local boom:

- It has resulted in a large influx of engineers trained in numerous different foreign countries. The industry has also seen the inevitable accelerated promotion of relatively inexperienced engineers in key decision making positions. This has diluted the expertise needed in project teams to design pipelines for the unique Australian conditions. The potential consequences are the increased health, safety and environmental impacts from poor design. These are only revealed during the construction or the operational phases of the pipeline (and associated facilities). The cost penalties associated with these inefficient designs can be very high.
- To cope with the high volume of work with tight deadlines, there may be a tendency for companies to develop pipeline engineers in a narrow sense only. E.g. pipeline engineers may, for several years, solely work on pipeline hydrodynamic stability design, and then be promoted to a lead engineer within the span of 5 – 6 years, without understanding the basics of general pipeline engineering. It is unfortunate that many companies, under the pressure of delivering a high volume of work, focus only on the necessary output requirements from engineering professionals, and not on the professional development of the individual.[3]
- Remuneration rates for even the younger and relatively inexperienced offshore pipelines engineers have been known to become extremely high. This has the potential to negatively affect the personal development of these individuals.

Apart from the direct immediate negative impacts, the above have a long term adverse effect on the reputation of the offshore industry.

Developing a pipeline engineer training program through APIA will assist in providing the necessary tools to pipeline operators, pipeline engineering consultants and pipeline installation contractors to assess, screen and develop their engineering professionals in the broadest sense.

The offshore pipeline engineer training program will serve the same objectives as those for the onshore pipeline engineers:[1]

- Accelerating the rate at which engineers develop expertise
- Providing a clear career path for engineers
- Providing a new emphasis on the value and importance of pipeline engineers
- Providing a vehicle to assist communication about pipeline engineering, and raise its profile
- Help engineers see themselves differently; i.e. recognise their importance to business and society
- Place engineers in a position to better manage their professional liabilities through high standards of competence and expertise
- Increase the recognition by society that pipelines are safe and reliable means of transporting hydrocarbon products.

Onshore and Offshore Pipeline Industries

The combined onshore and offshore pipeline industry in Australia is officially represented by APIA. Historically, the Australian pipeline industry commenced onshore, with the construction of the first hydrocarbon pipelines in the early 1950s. The first offshore pipelines were not installed until the late 1960s. To date, there are approximately 30,000 onshore pipeline kilometres in Australia transporting hydrocarbons, compared to approximately 3,000 offshore pipeline kilometres.

Despite the common organisational representation in APIA, the onshore and offshore pipeline industries in Australia reside in two different worlds, albeit side by side. The onshore pipeline industry in Australia is largely a national affair. Design consultants today are pre-dominantly Australian owned companies. So are most of the construction contractors, although sometimes international construction contractors have contributed and are still contributing today. Pipeline operators are today principally Australian owned. In contrast, the offshore pipeline industry in Australia is a part of an international affair. Design consultants are predominantly owned by foreign companies, although recently there appears to be a shift to Australian owned consultants in this industry. Pipeline construction contractors, with the exception of perhaps one or two relatively small companies, have always been foreign owned. Operators of offshore pipelines are a mix of Australian owned and foreign owned companies.

The current onshore pipeline design code in Australia, AS 2885, is an Australian code, developed by Australians. While offshore pipelines are covered under AS2885.4, this part basically refers to an international standard DNV OS F101, which is used globally.

Pipeline conventions attended by both industries show a similar picture of national versus international characteristics of the onshore and offshore industries respectively. The most comprehensive onshore pipeline engineering conference attended by Australian onshore pipeline engineers is the annual APIA convention. Those attended by the Australian offshore pipeline engineers are held overseas: e.g. Offshore Pipeline Technology Conference (held annually in Amsterdam), Offshore Technology Conference (held annually in Houston), Ocean Offshore and Arctic Engineering Conference (held at varying locations worldwide – San Francisco in 2014), Ocean and Polar Engineering Conference (held at varying locations worldwide – Busan in 2014), to name a few.

While there will always remain significant differences between these two industries in terms of their modus operandi and cultures, it has been recognised by some in both industries in Australia, and by APIA, that closer collaboration between onshore and offshore will significantly enhance safety, efficiency and effectiveness of design, construction and operation of pipelines. The obvious point of primary interest is where both industries sometimes meet, which is at the shoreline. Remarkably, most offshore pipeline consultants either shy away or do not have the capability of designing the pipeline section above the low water mark (even though the codes classify this section as part of the offshore pipeline system). Similarly, onshore pipeline consultants prefer to stay well above the high water mark. Long tidal flats are therefore prone to be under-designed. Consequently, this area is one where urgent action is required, to bridge the gap in collaboration between these two valuable Australian industries.

Similarities and Differences between Onshore and Offshore Pipelines

This Section provides a general overview of the main similarities and differences between onshore and offshore pipelines, without being all-inclusive.

Engineers

Engineers in both onshore and offshore pipeline industries have very similar, if not the same, education. Most have a university degree in mechanical or civil/structural engineering. Sometimes you will find those with a university degree in environmental engineering, chemical engineering or even electrical engineering. Some Australian universities provide specialist marine and/or offshore engineering courses (e.g. AMC and UWA), either as a Bachelor Course or as a Master Course

The industry itself (operators, consultants and construction contractors) always provides in-house and external training to graduate engineers to fill-in the knowledge gap between the university education and the industry requirements.

Linepipe Materials

The major onshore and offshore pipelines which transport hydrocarbon products are made of carbon steel. A subtle difference exists in the cost-effectiveness of steel grades higher than API 5L X65 (DNV OS F 101 grade 450). The reduced wall thickness for higher grades steel is cost-effective onshore. However, offshore, for a number of reasons (submerged weight predominantly) the use of a higher grade steel is not necessarily cost-effective.

Hydrocarbon products are quite often transported over a significant length through offshore pipelines to shore without offshore treatment or product separation, resulting in so-called multiphase flow. This has a large impact on linepipe material selection. This is not often seen onshore.

Exotic steel materials, such as corrosion resistant alloys and cladded pipe, are also very often used offshore. This is dictated by high product temperature, corrosive products, high erosion rates, and the like, near the wells. Onshore this is only used for onshore gathering lines. Both industries also use flexible linepipe material. However, their material specifications are vastly different.

Pipeline Routing, Stabilisation and Protection

Pipeline route selection, stabilisation and protection design is an essential design activity for both onshore and offshore pipeline projects. The main differences between onshore and offshore pipelines in this regard are:

- Route selection for onshore pipelines has a much larger land-ownership management component compared to offshore pipelines.
- Offshore pipeline route seabed data (bathymetry and geotechnical data) is in most cases not readily available given that it is hidden by a vast layer of ocean water. Offshore site data collection surveys are much more costly compared to onshore surveys.
- Offshore pipelines are commonly placed onto the seabed with no other protection than its steel wall thickness in combination with a concrete weight coating.

- Offshore pipeline stabilisation against hydrodynamic loads is a major design component in Australia. Onshore pipeline stabilisation design is limited to wet areas in onshore pipeline routes.
- Protection of offshore pipelines against accidental external impact follows a different process than that used for onshore pipelines.
- Onshore pipeline projects need to account for challenging crossings such as meandering rivers, swamps, roads, railway lines, populated areas, environmental sensitive areas. Offshore pipeline projects need to account for other challenging crossings, such as subsea canyons, mudflow channels, unstable subsea slopes, rough seabeds, shore approaches/shore crossings.
- Onshore pipelines are more commonly cathodically protected using impressed current systems. Offshore pipelines are more commonly cathodically protected using sacrificial bracelet anodes attached to the pipeline at discrete intervals.

Construction

The onshore pipeline industry has, over the years, developed its unique construction equipment, and arguably the most famous one is the side-boom. The logistics which have been developed to construct pipelines across the Australian mainland are impressive. The industry has developed an effective construction sequence of pre-trenching, stringing, welding/NDE/field joint coating, lowering and backfill spreads which travels through the landscape. In addition there are the complex logistics associated with the supporting accommodation camps. These are erected, dismantled, transported and re-erected every month or so along the pipeline right-of-way as the construction caravan advances at a rate of typically several kilometres every day.

The mere presence of the water above the pipeline installation surface (seabed) has resulted in the development of specialist offshore pipeline construction vessels which accommodate all workers on-board. Welding/NDE/field joint coating occurs in the so-called “firing line” of the pipelay vessel, after which the pipeline is laid onto the seabed at a rate of also several kilometres every day.

For decades, semi or fully automatic welding has been a standard practice in the offshore pipeline industry. These technologies have only relatively recently been introduced in the onshore industry, and then only for large diameter pipelines.

Offshore Pipeline Engineering Competencies

The development of the Offshore Pipeline Engineering Competencies has followed the same outline as the one which was developed earlier for the Onshore Pipeline Engineering Competencies.[1]

A small reference group of experienced pipeline engineers from a range of different backgrounds and employers, including several reputable Perth-based operators, have teamed up with the APIA representatives Chris Harvey (Chris Harvey Consulting) and Eric Jas (Atteris Pty Ltd) to work on the development of the Offshore Pipeline Engineering Competencies.

Battery Limits

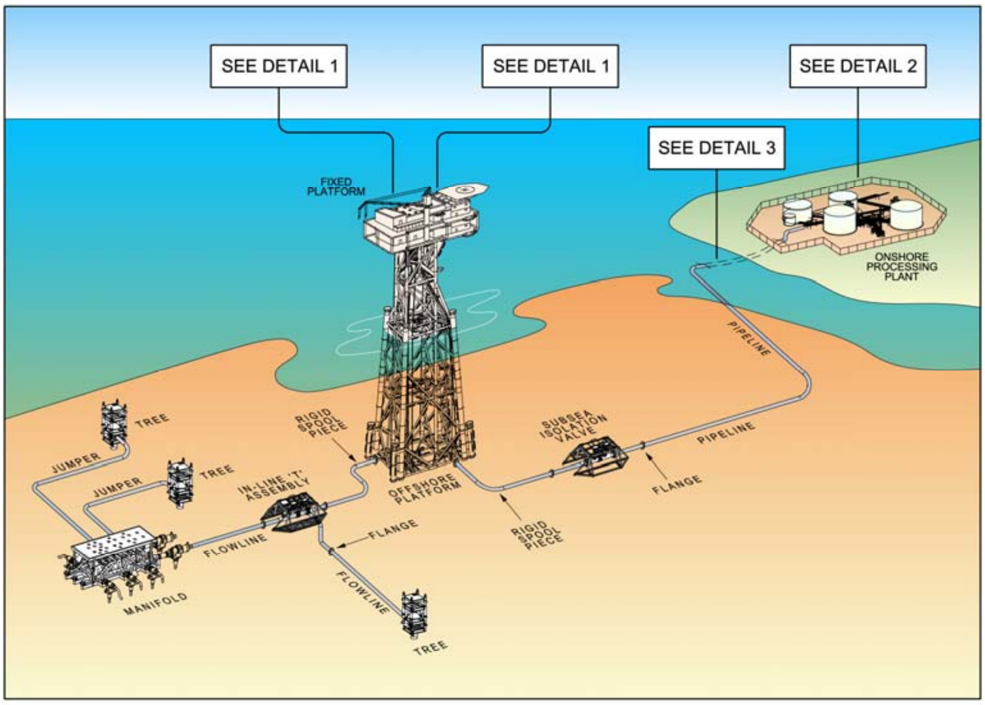
The following battery limits have been agreed:

- Onshore: At the tie-in weld with the onshore pipeline, which is typically above the high water mark, where the sandy beach meets dune vegetation or in the case of a coastal cliff, inland from the cliff face in respect of the pipeline vertical alignment profile (for conventional open cut & cover shore crossing design). In the case of a HDD or tunnel, the onshore battery limit is at the onshore tie-in weld near the HDD/tunnel onshore extremity.

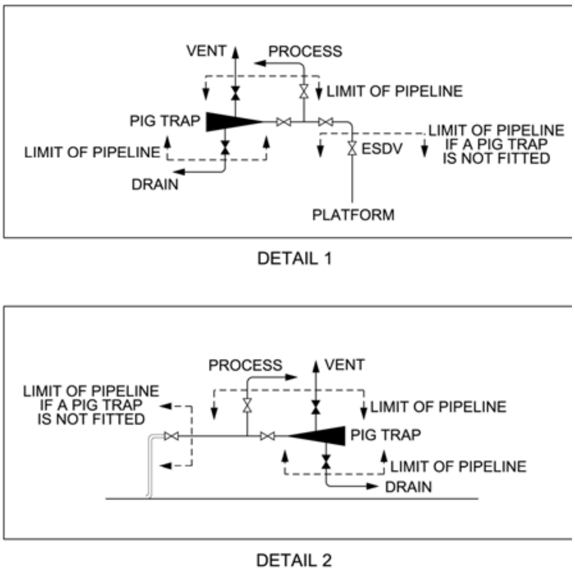
- Offshore:
    - At fixed platforms, up to and including the pig launcher/receiver
    - At floating facilities, up to the riser hang-off point
    - At manifolds/trees, up to the manifold/tree

- Inclusions
    - All rigid pipe (carbon steel, duplex steel, alloys)
    - All flexible pipe
    - Bends, mechanical connectors (flanges and the like), in-line TEEs
    - Fixed (rigid) and flexible risers, including steel catenary risers (SCRs), and jumpers
    - Tie-in spools
    - Umbilicals and power cables

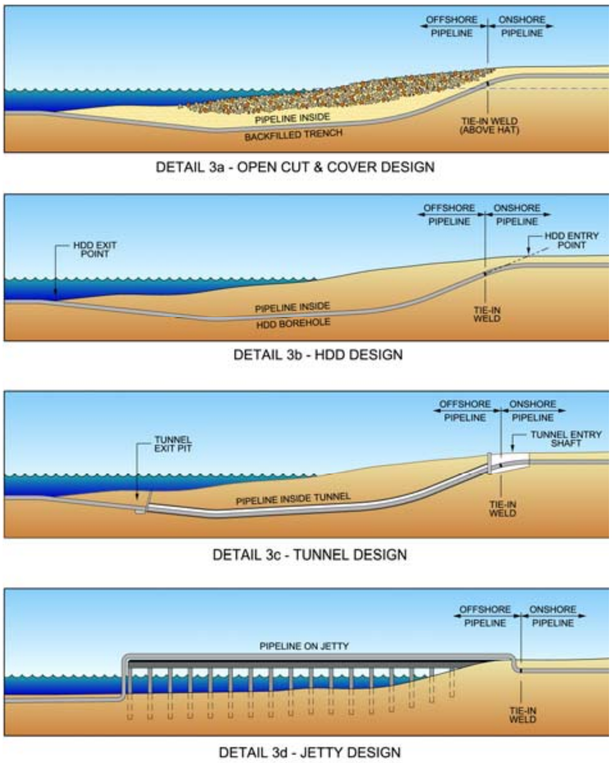
- Exclusions
    - Onshore pipelines
    - Platforms, floating facilities
    - Subsea pipeline end manifolds (PLEMs), subsea trees, subsea manifolds/skids, subsea valves



FIELD DEVELOPMENT SCHEMATIC (FIXED PLATFORM)



GEN-MS-0014.002_A 15.02.1:



GEN-MS-0014.003_A 07.03.

Competency Areas

The development, which is still in its early stages, will cover the following main competency areas:

- General Engineering
- Industry Background
- Flow Assurance/Process Engineering
- Corrosion Control and Materials Engineering
- Safety Management and Risk Assessment
- Commercial Aspects
- Environment and Heritage
- Pipeline Corridor Management
- Design of Offshore Pipelines
- Design of Pipeline Related Structures
- Shore Approach Design
- Design of Risers (Rigid, Flexible, SCRs) & Tie-in Spools
- Seabed Data Acquisition
- Metocean Data Definition
- Construction Engineering & Management
- Offshore Pipeline Project Management
- Welding
- Hydrotest, Commissioning and Preparation for Operation
- Asset Integrity Management and Pipeline Operations
- Safety Case

A total of just over 200 competencies have been identified. The reference group is currently writing the competency requirements for approximately 30 competencies. They are being classified into a competency structure consisting of three dimensions:

1. Level – Core, elective, specialist
2. Stream – General, Design, Construction, Operations (including maintenance and decommissioning)
3. Competency area.

The plan is to have these competencies reviewed by a wider industry group, including operators, consultants, contractors and regulators, to gather valuable feedback. Then, the remaining 170-odd competencies can be written and reviewed, followed by publication.

As with the onshore pipeline competency standards, the offshore competency standards are designed to be a flexible and effective tool for employers of pipeline engineers, pipeline engineers themselves, training organisations and APIA itself. There are multiple applications for the Competency Standards including:

- Determining if a pipeline engineer is competent for a particular role or activity
- Improving clarity of job descriptions
- Competency gap analysis – at industry, company, department and individual level
- Recognition of current skills and knowledge
- Recruitment
- Creating pipeline engineer development plans
- Development of pipeline engineer training programs
- Personal career planning.

Conclusion

The Australian pipeline industry has a very good reputation worldwide. We are known for our vast network of highly reliable, high-pressure, long-distance transmission pipelines onshore. Australia is also highly regarded as a centre of excellence in the field of offshore geotechnics in support of, amongst others, offshore pipeline design. Our contribution to improving offshore pipeline design codes, used globally, in particular in relation to pipeline hydrodynamic stability design, is notable. To continue to operate at a high standard, we must, as a nation, formalise the competency requirements in a system which can be used nationally in both onshore as well as offshore pipeline industries. We must also, in this regard, close the gap between onshore and offshore, in particular where both industries sometimes meet, which is at the shoreline. This project is still in its early stages, and will ultimately require involvement from a much wider industry audience, including contractors, consultants, operators and regulators. The objective from APIA's perspective is the continued safety and longevity of the nation's vital gas transmission infrastructure networks onshore as well as offshore.

References

1. Chris Harvey, Planning Ahead for Pipeline Engineer Training, APIA Convention Brisbane, October 2010
2. www.globalinfo.com
3. Axelrod and Coyle, Deliver Results and Develop People at the Same Time, American Management Association, September 2013