Shallow water experiences in Asia
Pocket development, field extension, PRP and EORs

SKK MIGAS Day
Guillaume Lemaire, Jakarta, 27th September 2016
Flexible Pipe Design – General Presentation

- Main applications:
  - Crude oil production
  - Gas production
  - Water injection
  - Gas injection
  - Export pipeline (dead oil, gas)
  - Gas lift
  - Service line (Chemicals, Gas Lift etc…)

- Static flowlines or dynamic risers

- From 2" to 20" ID

- Service Life 20, 30… 40 Years

Flexible pipe design offering Tailor made solution optimized according to client specific needs (fluid, diameter, pressure, temperature)
SO WHAT IS FLEXIBLE MADE OF?

The key layer in contact with the fluid is the plastic pressure sheath.

Plastic to seal the bore and to protect from external environment.

Metal to provide mechanical resistance.
One Technology, different performances & costs

Typical Shallow water pipeline
Static application
Low/No Tension
Average collapse & crushing resistance
Average Pressure 300-900# (150barg)

Typical Deep water Riser
Dynamic riser
High Tension & Fatigue
High collapse & crushing resistance
High pressure 2500#+
Insulated

COMPLEXITY

COST
Typical Examples of Applications, Indonesia

**Static**
- Shallow Water: CONOCO PHILLIPS, Tembang
- Deep Water: CHEVRON, Bangka

**Dynamic**
- Shallow Water: ENI, Jangkrik
- Deep Water: CHEVRON, Bangka
Flexible pipe used in **Shallow Water**

**Static**
- Pipeline platform to platform
  - Spool + Riser
  - Pre-installed J-Tube
  - Hang Off flange

**Dynamic**
- FPSO to WHP jumpers
- FPSO/ FSO/FSRU... risers to PLEM

**Riser / Spool**
- Riser section
- Flowline section
- Subsea connection
- Rigid Riser

**Riser + Flowline**
Developments & Flexible Pipe
Field development and flexible pipe in shallow waters

**EPS**: Early Production System

**Field in Production**

- **Green Field**: FPS (FLNG, FPU, FPSO, FSO) are broadly used for major development for export and/or marginal fields as main facility
- **Field Extension**: Limited facility scope (WHP mainly) and small diameter-short distance tie-backs
- **EOR**: High pressure Water injection and Gas Injection for short distance

**EPS**: usually involved minimal fixed facility and/or lease facility (MOPU, FPSO, FSO)

**PRP**: Congested field and corrosion issues with limited change on top-sides

**Concept FEED**

**Construction**

**Life extension**
Marginal Field and EPS
Early Production System challenges

- Limited CAPEX involving usually one WHP and one process & export facility
- Potentially leased assets for FSO, FPSO and MOPU involving flexible pipe risers
- Short distance tie-back between floating platform and WHP
- Lines with potentially high pressures (Safety valve on the main facility not the WHP) leading into 900#+ pipeline rating
Sepat Flexible Riser Supply

- **Client:** Petrofac

- **Location:**
  - 130km offshore Terengganu, Peninsular Malaysia
  - Water Depth: 70m

- **Scope of supply:**
  - 1 of 200m 6” Production riser
  - 1 of 200m 6” Gas Injection riser

- **Manufactured:**
  - Technip - Asiaflex Products
Client Driver for decision

- Fit for purpose design by dedicated local team
- Maximize local content from Malaysia perspectives
- Quick delivery thanks to local supply (no transportation additional lead time)
- Competitive pricing
Green Field
Full Field Development
Greenfield with floating platforms challenges

- **Flexible pipe required for riser sections if floating platform involved**

- **CAPEX cost**
  - Flexible riser installation as standalone cost represent significant CAPEX
  - Riser if connected to rigid pipeline involve a PLEM
  - Floater usually arrive at the latest stage and is on the critical path
  - Unlock synergies with floating platform mooring, umbilical or subsea equipment installation

- **Project Schedule**
  - Shorten project duration as riser installation is on the critical path of the schedule
  - Optimize the FPSO to platform requirement avoid unnecessary chemical injection skid and pigging facilities
Petronas FLNG Satu Risers & Flowline

- **PFLNG SATU**
  - Tie-back to Kanowit CPP
  - 10” Dynamic Riser + 3km Flowline Tie-back
  - Installed in one campaign together with offshore modification of CPP
  - EPCI by Technip
**Client Driver for decision**

- EPCI package covering all aspect of the pipeline up to top side work
- Lower CAPEX costs with one vessel installing both riser and moorings
- Same line (flexible) between FLNG and CPP (no carbon steel pipeline maintenance involved)
- Reduced exposure to late delivery (pre-installation of the line)
- Quick installation (only 15 days offshore)
Field Extension
Field extension challenges

- CAPEX costs
- First oil/gas as soon as possible
  - Pipeline may be on the critical path
  - Offshore campaign might be split on two monsoon seasons if offshore work is significant
  - SIMOPS might be an issue
- Limited facility/pipeline scope of work reducing offshore work synergies
- Limited modification are expected on the existing platform(s)
Shell Laila & D12

- **Project**
  - Sarawak Shell Berhard (SSB)
  - Laila and D12 fields, offshore Sarawak (Malaysia)
  - Field extensions btw. existing fixed platforms to new build fixed platforms
  - Water Depth: 71-76m (Laila) - 50m (D12)

- **Scope of work**
  - EPCIC project
  - Supply of 10.1km of 12.8" flexible wet gas production flowline
  - Supply of 5km of 7.5" flexible wet gas production flowline
  - Manufacturing facility is Asiaflex Products
  - Installation by Deep orient
  - Pre-commissionning

- **Key Dates**
  - Award: August 2012
  - Installation: July 2014
Client Driver for decision

- EPCI package covering all aspect of the pipeline up to top side flange
- Reduced exposure to waiting on weather during installation (lump sum contract)
- Lower CAPEX costs with one vessel installing both riser and moorings
- Diverless installation (for one field)
- Lower OPEX costs
EOR, Field Rejuvenation
EOR challenges and facts

- CAPEX costs
- High pressure pipelines (600# to 2500#)
  - Water injection lines involving maintenance if carbon steel design is selected
  - Gas (Re)Injection which could be sour
- Small diameters in the range of 4-10”
- Short length pipelines in the range of 1-15km
- Use of existing platforms that weren’t design for EOR purpose
  - No riser slot might be available
  - Additional deck extension to accommodate pig launcher/receiver and corrosion inhibition skid
- Multiple crossing along the lines and/around existing platforms
Greater D18 Flexible EPCI

- **Client**: Petronas Carigali
- **Location**
  - North of Miri, Sarawak, Malaysia
  - Water Depth: 35m
- **Concept**
  - Additional water injection to existing field
- **EPCI** for 2-off 8” water Injection flowlines [5.5km + 4.8km]
Greater D18 Flexible EPCI Execution

28 October 2015 - Mobilization Asiaflex

2nd November 2015 1st pipe in the water
Greater D18 Flexible EPCI Execution

4th November 2015 Last pipe laying

8th November Offshore campaign completed
Client Driver for decision

- Smooth bore design for Water injection pipeline
  - Lower impact on topsides: small/no pig launcher, no corrosion inhibitor injection skid
  - Corrosion free design

- Lower CAPEX costs
  - Small diameter pipelines install with small vessel (No S-lay barge mob/demob)
  - Optimized pipeline routes, easy crossings and platform approach

- Project benefits
  - Reduced exposure to risk during installation:
    - DP vessel allows eliminate risks of anchors impacts to existing pipelines
    - Combined installation with power cable or umbilical
    - Quick installation (only 15 days offshore)
Pipe Replacement
Pipe Replacement projects challenges and facts

- Many lines have no continuous injection facilities and required batching injection on unmanned platform all along the year (monsoon period included)
- Lines are facing significant corrosion issues
- High risks of drop anchors for existing pipelines during installation (congested fields)
- Multiple crossing along the lines or around existing platforms
- Difficult new pipeline route definition due to congestion and/or corals
- Replacement lead time and Uptime is always at stake
PRP program: our understanding of your current issues and how flexible can address them

**Agenda of Pertamina**
- Reliable Technical solution for increasingly corrosive environment
- Cost effective (life cycle cost – CAPEX and OPEX)
- Limited impact on existing facility (modification, shutdown)

**Issues raised by current solutions**
- Highly sensitive to corrosion
- Recurring costs (shutdown, chemical injection)

**Carbon steel rigid pipes**
- Very few track record offshore
- Limited in temperature and diameter
- On-bottom stability (floating pipe)
- Ageing (synthetic fiber)

**RTP**

**How flexible can help**
1. Lower Capex, less risky and easier installation
2. Very limited OPEX (corrosion free), optimized uptime
3. Easy and fast project execution (PTTI PMT and Engineering team in Jakarta)
4. Local content (engineering, logistics..)
### 6.0” Flexible pipes (API 17J) v.s RTP (API 15S)

<table>
<thead>
<tr>
<th></th>
<th>FLEXIBLE PIPES</th>
<th>RTP</th>
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<tbody>
<tr>
<td><strong>Application</strong></td>
<td>Subsea and Topside</td>
<td>Mainly onshore</td>
</tr>
<tr>
<td><strong>Track Record</strong></td>
<td>11,000 km worldwide, up to 40 years design life</td>
<td>Few pipes laid subsea. Very little feedback on operation / installation</td>
</tr>
<tr>
<td><strong>Design</strong></td>
<td>Heavy pipe (equivalent to rigid pipe) Resistance to collapse</td>
<td>Buoyant pipe Unproven collapse resistance Maximum water depth of 30-40m Limited resistance to corrosive fluid</td>
</tr>
<tr>
<td><strong>Leak Risk</strong></td>
<td>1 off connection every 5 km</td>
<td>1 off connection every 220 m</td>
</tr>
<tr>
<td><strong>Lay rate</strong></td>
<td>400 m/hr</td>
<td>Many intermediate connections and concrete blocks, unknown lay rate</td>
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</tbody>
</table>

Flexible is dedicated to subsea market with large track record  
Flexible pipe are heavy and can be laid without concrete mattress and multiple flanges connections  
Flexible design is catering for collapse risk and highly corrosive fluids
Flexible : limited OPEX, no shutdown
Example of a Technip flexible used by Saudi Aramco

Flexible line installed in 1984
- For Saudi Aramco, project Qatif Flank-1
- Arabian Gulf, Saudi Arabia
- 8” ID Water Injection line, from shore to 15m water depth

Sample recovered in 2013 - 29 years after
- All layers still in perfect conditions
- Maintenance from 1984 to 2013:
  - Pigging: 0
  - Cleaning: 0
  - Corrosion inhibitor: 0
  - Subsea inspection: visual only

Sample recovered after accidental breach onshore

Conclusion
- NO OPEX spent by Saudi Aramco during 29 years (no corrosion)
- No shutdown
- Service life over 40 years
Specific Benefits of Flexible pipe for PRP

- **Customized design**
  - Lined pipe design (called smooth bore) for Water injection pipeline
  - High temperature and pressure gas injection design with customized internal diameter

- **Lower CAPEX costs**
  - Lower CAPEX for short length and small diameter pipelines
  - Optimized pipeline routes, easy crossings and platform approach
  - Lower impact on topsides: small/no pig launcher, no corrosion inhibitor injection skid

- **Project benefits**
  - Reduced exposure to risk during installation:
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Pocket Development
Supply low cost, re-useable, SPS, SURF and facilities equipment to enable otherwise economically unfeasible hydrocarbons to be produced from small greenfield or brownfield assets.

- Up to 3 wells, depleted to a small CAPEX efficient FPSO in water depths < 75m to > 500m
- Standardized wellhead and subsea tree components, compact in-line tees, flexible flowlines and an umbilical
- Satisfy industry codes with clear functional requirements
- Data collection critical to enable business case
Pocket Development Messaging

Asia Pacific

Client Driver

- Cost effective (life cycle cost – CAPEX and OPEX) field development
- Maximize hydrocarbon production
- Robust technical solution
- Maximum local content

Alliance Offering

- Incentivized commercial model with low-cost, re-useable SPS, SURF and facilities
- Provide life of asset services with data collection to optimize uptime
- Field-proven solutions designed for multi-fields use
- Engineered, managed and manufactured locally in Asia Pacific

Concept Phase
Pocket Development Solution – Brownfield (Gas)

Total well to facility solution
# Technical Proposition

**Pocket Development Solution**

<table>
<thead>
<tr>
<th>Option ‘A’</th>
<th>Option ‘B’</th>
<th>Option ‘C’</th>
<th>Option ‘D’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Depth</td>
<td>&lt; 100 m (diver assist)</td>
<td>100 to 500 m</td>
<td>100 to 500 m</td>
</tr>
<tr>
<td>Hydrocarbon</td>
<td>Oil or low rate Gas</td>
<td>Oil or high rate Gas</td>
<td>Oil or high rate Gas</td>
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<tr>
<td>Host Facility</td>
<td>Greenfield</td>
<td>Brownfield</td>
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<tr>
<td>SURF</td>
<td><img src="image1.png" alt="Image" /></td>
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<td><img src="image3.png" alt="Image" /></td>
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<tr>
<td>SPS</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
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<tr>
<td>Drilling Platform</td>
<td><img src="image9.png" alt="Image" /></td>
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Project Execution
Flexible Pipe Activity Managed Locally Engineering, PMT and Manufacturing

Engineering and PMT
Based in Jakarta
Total 66 People

Manufacturing at ASIAFLEX
Facility in Johor, Tanjung Langsat
450 People full time
Take Away

- Flexible pipe is an alternative to flexible pipe for multiple cases in shallow water bringing
  - Lower CAPEX costs
  - Lower OPEX costs
- Technip has Local capabilities in Indonesia to support these developments
- Combining flexible pipes and subsea trees is an efficient way of developing competitive tie backs
Thank you

For more information, please contact

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