### Pipeline Anchoring Via Bi-Flex Concrete Mattresses for Subsea Applications

Vladimir CAPINDISSA / Vanio CORREIA TOTAL E&P Angola)





MILAN MARRIOTT HOTEL • MILAN, ITALY • 9-11 APRIL 2018

#### Agenda

- 1. Pipeline Walking Phenomena
- 2. Walking Phenomena on TEPA Water Injection Lines (TOTAL E&P Angola)
- 3. Pipeline Walking Mitigation Measure / Pipeline Anchoring Implemented on TEPA
- 4. Bi-Flex Concrete Mattresses Subsea Installation / Deployment
- 5. Overview of Concrete Mattresses Installation on Block 17 for Mitigation Scopes
- 6. Conclusões



#### 1. Pipeline Walking Phenomena

- Pipeline walking phenomenon is very common on water injection pipelines.
- It is triggered by thermal cycles shutdown/startup sequences.
- It creates progressive axial displacement harmful to the integrity of the pipeline itself.
- The temperature is the key factor and has a strong influence on the walking.
- Shutdown (SD)/ start-up (SU) thermal cycles generates the following behaviours of the pipeline
  - Pipeline thermal expansion (warming phase SU), and
  - Pipeline thermal retraction/contraction (cooling phase SD).



# 2. Walking Phenomena on TEPA Water Injection Lines (TOTAL E&P Angola)

- The pipeline walking is featured as integrity threat as it may compromise the integrity of the pipeline.
- Pipeline rupture due to lateral buckling; already experienced by TOTAL E&P Angola back to 2008 Girassol WI line15).
- It may lead to pipeline failure and consequently to production losses.
- TOTAL E&P Angola has been experienced pipeline walking on several water injection lines.
- A task force has been created to mitigate the impact of potential pipeline failures and preserve their integrity.



# 3. Pipeline Walking Mitigation Measure / Pipeline Anchoring Implemented on TEPA

- Pipeline anchoring strategy has been classified as a task force to mitigate the walking.
- The anchoring strategy is based on putting some weight on top of the pipeline increasing the friction loads.
- It consists on installing Bi-Flex Concrete Mattresses on top of the line.
- These concrete mattresses are designed for subsea applications.



# 4. Bi-Flex Concrete Mattresses Subsea Installation / Deployment

• The concrete mattresses used are articulated bi-flex taper edge type.



Parameter	Value
Manufacturer	Pipeshield
Mattress type	Bi-Flex
Density	2.4kg/m3
Length	6m
Diameter	3m
Thickness	0.3m
Weight in air	8.52t
Weight in water	4.88t



# 4. Bi-Flex Concrete Mattresses Subsea Installation / Deployment (Cont.)

- The concrete mattresses are installed by quick release frames and beams that incorporate tubular members within the construction rated for water depth up to 200m.
- Development of an alternative frame design suitable for subsea applications was the innovative operational strategy.
- Two frames 7m x 2.7m have been built based on a solid steel section and without depth limitations.
- Vents and drains were added on the frames comprising screwed plugs and sealing washers.
- This allows that in normal operation are installed and sealed to prevent water ingress to internal corrosion.



# 4. Bi-Flex Concrete Mattresses Subsea Installation / Deployment (Cont.)

- The frames contain two release mechanisms (ROV operable).
- It defines the release sequence of each mattresses (first the bottom mattress and second the upper one).



Parameter	Value
Length	6m
Diameter	3m
Weight in air	2.5t
Weight in water	2.2t (Estim)
SWL	22.75t
Lifting points	2x x18 No



MCE Deepwater Development 2018 -

# 4. Bi-Flex Concrete Mattresses Subsea Installation / Deployment (Cont.)





MCE Deepwater Development 2018 -

## 4. Bi-Flex Concrete Mattresses Subsea Installation / Deployment (Cont.)





#### 5. Overview of Concrete Mattresses Installation on Block 17 for Mitigation Scopes







### 5. Overview of Concrete Mattresses Installation on Block 17 for Mitigation Scopes (Cont.)









#### 5. Overview of Concrete Mattresses Installation on Block 17 for Mitigation Scopes (Cont.)









#### 6. Conclusions

- TOTAL E&P Angola has successfully installed 320 concrete mattresses up to date (since 2016). All spreaded over different water injection pipelines with very good results in terms of anchoring purposes/effects.
- This mitigation strategy offers the benefits as follows:
- Reliability (anchoring effects confirmed);
- Low cost option (low procurement price of the concrete mattresses);
- Easy to deploy from a vessel of opportunity (user friendly dual deployment frame);
- No loss of production (mattresses can be installed with the pipeline flowing/live).
- The dual frame installation philosophy has proven to be efficient and effective.
- Good installation time optimization.
- Installation rate of 10 12 mattresses per day has been guaranteed offering good cost saving on vessel time and improving our excellence for the offshore







#### Thank you!!

#### **DISCLAIMER and COPYRIGHT RESERVATION**

The TOTAL GROUP is defined as TOTAL S.A. and its affiliates and shall include the person and the entity making the presentation. <u>Disclaimer</u>

This presentation may include forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995 with respect to the financial condition, results of operations, business, strategy and plans of TOTAL GROUP that are subject to risk factors and uncertainties caused by changes in, without limitation, technological development and innovation, supply sources, legal framework, market conditions, political or economic events.

TOTAL GROUP does not assume any obligation to update publicly any forward-looking statement, whether as a result of new information, future events or otherwise. Further information on factors which could affect the company's financial results is provided in documents filed by TOTAL GROUP with the French Autorité des Marchés Financiers and the US Securities and Exchange Commission.

Accordingly, no reliance may be placed on the accuracy or correctness of any such statements.

#### **Copyright**

All rights are reserved and all material in this presentation may not be reproduced without the express written permission of the TOTAL GROUP.

