High Paraffin Content and Long Distance –
A Particular Challenge for Cleaning and Inspection of a Crude Oil Pipeline

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Intention

- High paraffin contents represent a significant challenge when it comes to In-Line Inspection, especially in long distance pipelines.

- This case study demonstrates how this can be dealt with to receive quality inspection results.
Project Introduction

- Pipeline details:
  - onshore crude oil transport pipeline
  - 18“/232km long, built in 1988
  - located in Gabon, Central Africa
  - starts at Rabi oil field (Shell)
  - tie-ins from Coucal (Total) and Marathon’s offshore production
  - ends at Cap Lopez Tanker Terminal
What is different in this line?

- long distance
- low flow as production has decreased significantly
  - \( \rightarrow 0.2\text{m/s} / 0.43\text{m/s} / 0.66\text{m/s} \)
  - \( \rightarrow \text{approx. 5 to 6 days run time} \)
- high paraffin content in crudes' composition
Pigging background

- frequent bidi cleaning pig runs
- successful MFL inspection in 2003
- non-successful MFL inspection in 2008
  - inspection tool plugged with paraffin and inoperative after approx. 13km
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Steps of the Project Engineering:

- review all information about previous cleaning
- consider options for marking
- establish cleaning and inspection program
- design cleaning tools
- design inspection tools
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- Pipeline Cleanliness:
  - Experience from last inspection
    - small volume of soft paraffin during cleaning
    - large volume of hard paraffin plugged the inspection tool
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- Pipeline Cleanliness:
  - Experience from bidi cleaners
    - sometimes 20-50kg, sometimes hundreds of kg
    - consistency varies from soft to hard paraffin
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- Markering
  - approx. 150 marker locations required
  - right of way
  - entire project of its own to be synchronised with inspection pigging operations

- Solution:
  - from the 2003 inspection, a pipe tally and very well documented marker locations did still exist
  - 3P could align its data to the old pipe tally
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Picture: Right of way covered by jungle
Cleaning and inspection program:
- 3P to build suitable cleaning tools and transfer to Gabon
- TEPG to do a first cleaning with these tools
- 3P to check whether the cleaning was successful and the actual cleanliness of the line
- further cleaning operations if required
- MFL inspection
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- Cleaning tools to be applied:
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- Inspection tools to be applied:
  - GEO+:
    - combination of GEO and DMR sensors
    - measures internal diameter
    - distinguishes between paraffin and metal
  - → provides high value information on cleanliness of the line
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Picture: GEO+ tool applied
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- Inspection tools to be applied:
  - MFL:
    - high resolution MFL tool
    - very long battery life time (>6 days)
    - high „paraffin resistance“ package
Phase I – Pre-Cleaning

- TEPG ran cleaning pigs (one at the time)
- 3P reviewed results from Germany
- decreasing volumes of paraffin
  - 800kg per pig → <20kg per pig

- mobilised GEO+
Phase II – 3P gauging and cleaning

- after months of TEPG cleaning, 3P mobilised engineers, profile pig and GEO+
- profile pig run received with 100kg paraffin
Phase II – 3P gauging and cleaning

- further cleaning pig runs with multiple pigs in the line
- → approx. 500kg of paraffin has still been removed
Phase III – GEO+ Inspection

- Results of GEO+ inspection:

![Image of graph with Coucal and Marathon markers and GEO, DMR, ODO lines]
Phase III – GEO+ Inspection

- Results of GEO+ inspection:
  - no critical restrictions, but data degradation likely
  - paraffin issues locally restricted
  - good chance that MFL tool will recover behind Marathon Tee

- decision was taken to go for the MFL instead of doing further cleaning activities
Phase IV – MFL Inspection

- Results of MFL inspection:

![Graph showing MFL inspection results with markers for Coucal and Marathon]
Phase IV – MFL Inspection

- Results of MFL inspection:
  - odometer slippage between Coucal and Marathon
  - was aligned to 2003 distance measurement
  - only minor data degradation between Coucal and Marathon
  - correction factor was calculated for paraffin influence
  - several defects could already be verified which confirmed the results of the inspection
3P Services says...

Thank you!