Operations II

The Use of DP Assisted FPSOs for Offshore Well Testing Services

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The Use of DP Assisted FPSOs for Offshore Well Testing Services
PEMEX Exploración y Producción (PEP), as well as other oil companies World Wide, face close scrutiny from environmental agencies, civil organizations, fishing industry and tourism, amongst others.

Oil spills are penalized by government agencies, and have a very strong impact, including image towards society.
During well completion, repair, stimulation and measurement, the emanating flow is a mixture of products that may be highly polluting to both air and sea if not disposed adequately:

- Crude oil
- Water
- Solids
- Gas
- Chemical products used for well stimulation
Due to the need to characterize the product, all fluids are received by well testing equipment, in many cases through portable separators and test devices.

Whenever reception and/or storage facilities are not available, the fluids are flared.
This situation is mainly observed during the exploration and termination phases of a well, and complicated by an additional problem:

The lack of export pipelines or facilities to receive and process fluids
When fluids are flared, there are three main problems:

**Environmental**
- Air pollution
- Sea pollution, when flaring is not 100%

**Commercial**
- Flaring a commercially valuable product
- Fines

**Public Image**
To avoid flaring, wells are serviced by means of portable equipment, or equipment on the mobile unit.

In such case, the oil companies need:
- The portable test equipment
- A supply boat to transport
- In many cases the drilling unit/vessel has to remain in location
- A bar/tug to dispose to shore all products

This traditional approach may take 10-12 days.
PEMEX proposed a solution to this problem by incorporating systems and services that would:

- Process and characterize production
- Minimize environmental damage
- Recover oil and gas (in particular situations)
The idea was to incorporate a vessel to receive and process fluids from:

a. Well repair, completion and stimulation (well induction and cleaning)

b. Well measurement

c. Provide service to water producing wells

d. Provide production services during facilities maintenance

e. Provide service to gas producing wells
Sub-Products

- Solids
- Fluids
- Solids and fluids
- Separation
- Packed under CRETB Code
- Confinement
- Temporary Storage. (Vessel)
- Re-injection of industrial waste wells
In 1997 the first of these vessels, the “Cora”, began operations.

The vessel was characterized by PEMEX as an “Ecological Ship” and served them until the end of 2003.
M/V “Cora”

It served PEMEX for Seven (7) years, attending more than 800 locations from 1997 to 2003.

It has been decommissioned.
To replace the Cora, and to improve the services, PEMEX awarded two-four year contracts for the following vessels:

**FPSO-DP2 Toisa Pisces**

**FPSO-DP2 Bourbon Opale**

Both contracts were awarded to Marecsa via International Public Tenders.
Main requirements were:
Classification from a member of the IACS:
- FPSO “Floating, Production, Storage and Offloading”
- Dynamic Positioning DP-2 or equivalent
- Certified helideck. Bell 412 or larger
- Double hull
Automation for the following systems (minimum)
- Engine Room
- Process Control (PCS)
- Fire and Gas (F&G)
- Emergency Shutdown (ESD)
Products to be returned to PEMEX must have the following characteristics:

- **Crude Oil**
  - % Water: 2% Maximum
  - Salt in crude: 25.0 lb/MBbl
  - Sediments: 0.5 % in weight

- **Gas**
  - Separation for re-injection to process or flaring

- **Oily water/ chemical products**
  - pH: 6 – 8
  - Solids: smaller than a 100 Microns

- **Solids**
  - Storage to CRETIB Code and disposal to confinements
<table>
<thead>
<tr>
<th><strong>FPSO – DP2 “TOISA PISCES”</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length:</strong> 103.50 m</td>
</tr>
<tr>
<td><strong>Depth:</strong> 9.10 m</td>
</tr>
<tr>
<td><strong>Speed:</strong> 14.0 knots</td>
</tr>
<tr>
<td><strong>Flag:</strong> Liberia</td>
</tr>
</tbody>
</table>
Production System. Toisa Pisces

- Production System: 20,000 BPD
- Gas: 36.00 MMSCFD
- Oily Water: 4,200 BPD
- Crude density range: 14 to 43° API
- Design: NACE (H₂S)
- Max. Temperature: 130° C
- Max. Pressure at Wellhead: 10,000 psi
- Process Pressure: 1,412 psi
- Storage: 24,000 bbls
Main Deck. Export and Re-injection Pumps
FPSO-DP2  “Bourbon Opale”

Length: 90.70 m  Breadth: 18.80 m
Depth: 7.60 m  Autonomy: 40 days
Speed: 14.0 knots  L. Quarters: 54
Flag: Mexico  Year Built: 2004
• Production System: 15,000 BPD
• Gas: 27.00 MMSCFD
• Oily Water: 2,800 BPD water
• Crude density range: 14 to 43° API
• Design: NACE (H₂S)
• Max. Temperature: 130° C
• Max. Pressure at Wellhead: 10,000 psi
• Process Pressure: 1,412 psi
• Storage: 10,500 bbls
Process Deck
## Results to Date “Toisa Pisces”

Results: March 2004 – September 2005

<table>
<thead>
<tr>
<th>TYPE OF SERVICE</th>
<th>TOTAL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAVY CRUDE OIL TESTING</td>
<td>23</td>
</tr>
<tr>
<td>OILY WATER REINJECTION</td>
<td>14</td>
</tr>
<tr>
<td>WELL CLEAN-UP</td>
<td>11</td>
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<tr>
<td>CRUDE EXPORT</td>
<td>36</td>
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<tr>
<td>WELL INDUCTION</td>
<td>114</td>
</tr>
<tr>
<td>OTHER</td>
<td>7</td>
</tr>
<tr>
<td><strong>TOTAL INTERVENTIONS</strong></td>
<td><strong>205</strong></td>
</tr>
</tbody>
</table>
Results to Date: “Toisa Pisces”

SERVICES PROVIDED BY THE VESSEL
" TOISA PISCES "
Period: March-04 to September-05

- WELL INDUCTION: 56%
- HEAVY CRUDE OIL TESTING: 11%
- OILY WATER REINJECTION: 7%
- WELL CLEAN-UP: 5%
- CRUDE EXPORT: 18%
- OTHER: 3%
Results to Date “Toisa Pisces”

Comissioned: March 2004
Operations: 99.0%
Down time due to weather: 6.2%
Average time per location/service: 3.5 days
Crude oil recovered: 218,000 bbls
Oily water recovered/reinjected: 75,000 bbls
## Results to Date “Bourbon Opale”

### Results: July 2004 – September 2005

<table>
<thead>
<tr>
<th>TYPE OF SERVICE</th>
<th>TOTAL NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEAVY CRUDE OIL TESTING</td>
<td>71</td>
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<tr>
<td>WELL INDUCTION</td>
<td>77</td>
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<tr>
<td>WELL CLEANING</td>
<td>3</td>
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<tr>
<td>OILY WATER REINJECTION</td>
<td>12</td>
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<tr>
<td>CRUDE OIL DEHYDRATION</td>
<td>1</td>
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<tr>
<td>FLUID RECEPTION</td>
<td>5</td>
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<tr>
<td>CRUDE OIL EXPORT</td>
<td>20</td>
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<tr>
<td>OTHERS</td>
<td>2</td>
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<tr>
<td><strong>TOTAL INTERVENTIONS</strong></td>
<td><strong>191</strong></td>
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</table>
SERVICES PROVIDED BY THE VESSEL
"BOURBON OPALE"

Period: July-04 to September-05

- **HEAVY CRUDE OIL TESTING**: 37%
- **WELL INDUCTION**: 40%
- **WELL CLEANING**: 2%
- **OILY WATER REINJECTION**: 6%
- **OTHERS**: 1%
- **FLUID RECEPTION**: 3%
- **CRUDE OIL DEHYDRATION**: 1%
- **TRASIEGO DE ACEITE**: 10%

Results to Date: Bourbon Opale
Results to Date “Bourbon Opale”

Comissioned: July 2004
Operations : 99.0%
Down time due to Weather: 6.8 %

Average time per location/service: 2.5 days

Crude oil recovered: 215,000 bbls
Oily water recovered/reinjected: 79,000 bbls
The average time for well service/testing has been 3.0 days. Equivalent to 10-12 services/month/vessel

The average on the traditional approach would be 10-12 days/service. Equivalent to 3 services/month

Contracts will end in 2008, and the vessels are expected to provide repeated service to PEMEX
Vessel cost: $ 2.50 US/barrel of Installed capacity/day

Considering a 3 days average for a well test, service, including fluid reception would be in the order of 150,000 USD/Service.

Traditional approach, including the Mobile Unit, tug-barge for product disposal, portable test equipment, etc., may be in the order of 600,000 USD/Service.
In addition to the well service presently provided, these units may be used for the production at marginal or remote fields.

It is expected a larger demand of these type of vessels for the offshore production services.

As the field decline, the advantage of DP assisted FPSO will become even more evident.

The cost per barrel, compared to the installation of expensive sub-sea pipelines will show further benefits.