Getting Smarter and Productive with Real Time Surveillance System to Optimize Artificial Lift System and Production Management of Aset-5 PERTAMINA E&P’s Mature Field

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Title : Asset-5 Field Manager
Company : PERTAMINA EP Indonesia
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Executive Summary

- Currently NKL structure produces ~7,500 BOPD (YTD)
  - Total area for NKL’s block is 33.75 km² dan SKL block is 11.02 km²
  - In NKL, 32 out of 90 layers in production with estimated remaining reserves of ~17 mmboe
  - 132 wells drilled, of which only 116 are currently operational with production of ~7,500 BOPD with limitations & constraint coming from its self reservoir condition & the surface environment

- Production can be increased by 2,500 BOPD with peak production of ~10,000 BOPD
  - Reservoir: Limit from reservoir is ~11,000 BOPD
  - Wells: Limit can be increased from ~7,500 to 10,000 BOPD by:
    ▫ Drill 6 infill wells, workover 22 gas wells & Well service 12 oil wells
    ▫ Stimulation 8 wells, Lifting optimization of 20 wells and reactivation 24 wells.
    ▫ Upgrading surface facilities: Loading line, BS upgrading (@NKL, Site B & SKL), NKL gas utilization & upgrading production facilities

- Further feasibility study is required to evaluate the possibility and effectiveness of real time surveillance system implementasi in another lifting method in order to optimize the production of the wells.
Field History & Overview
Field History & Overview

Operator

- NIIHM 1897 – 1905
- BPM 1905 – 1942
- Japan 1942 – 1945
- BPM/SHELL/PERMINA 1945 – 1972
Field History & Overview

Louise-1

- BPM Operatorships
  - LSE-2 - 519

- Take Over by Japan @ WWII
  - LSE 520-624

- Tesoro/Tipco Operatorship
  - SS 816 - 943

- BPM/Shell/Permina operatorships
  - LSE 625-647

- TAC Medco-Pertamina
  - SS 943 - 1009
    - (2008-present)

- Pertamina EP
  - NNY-1031, LSE-1054 & 1055

Operatorships history

(1897-1905) Louise-1
Discovered by NIIHM

(1905-1942) BPM Operatorships

(1942-1945) Take Over by Japan @ WWII

(1945-1972) Tesoro/Tipco Operatorship

(1972-1992) BPM/Shell/Permina operatorships

(1992-2008) TAC Medco-Pertamina

(2008-present) Pertamina EP
### Field History & Overview

**NKL is Asset 5’s field with 116 producing wells in 32 layers producing 7,500 BOPD**

<table>
<thead>
<tr>
<th><strong>GGR ASPECT – CURRENT CONDITION</strong></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>OI P</td>
<td>: 153.82 MMSTB</td>
</tr>
<tr>
<td>EUR</td>
<td>: 44.72 MMSTB</td>
</tr>
<tr>
<td>RECOVERY FACTOR TOTAL</td>
<td>: 29%</td>
</tr>
<tr>
<td>REMAINING RESERVES</td>
<td>: 11.89 MMSTB (STATUS AS OF 1 JANUARY 2017)</td>
</tr>
<tr>
<td>CUMMULATIVE PRODUCTION</td>
<td>: 32.82 MMSTB (STATUS AS OF 1 JANUARY 2017)</td>
</tr>
<tr>
<td>RECOVERY FACTOR CURRENT</td>
<td>: 21.9%</td>
</tr>
<tr>
<td>OIL API</td>
<td>: 25 – 39 API</td>
</tr>
<tr>
<td>OIL VISCOSITY</td>
<td>: 0.49 – 1.6 cP</td>
</tr>
</tbody>
</table>

| **OIL IP**                        | : 123.59 BSCF   |
| EUR                               | : 71.02 BSCF    |
| RECOVERY FACTOR TOTAL             | : 57.4%        |
| REMAINING RESERVES                | : 28.58 BSCF (STATUS AS OF 1 JANUARY 2017) |
| CUMMULATIVE PRODUCTION            | : 42.44 BSCF (STATUS AS OF 1 JANUARY 2017) |
| RECOVERY FACTOR CURRENT           | : 34.3%        |
| DRIVE MECHANISM                   | : SOLUTION GAS DRIVE & WATER DRIVE |
| TOTAL NUMBERS OF LAYER            | : 90 LAYERS     |
| ACTIVE LAYER                      | : 32 LAYERS     |

<table>
<thead>
<tr>
<th><strong>PRODUCTION – CURRENT CONDITION</strong></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>TOTAL NUMBERS OF WELLS</td>
<td>: 132</td>
</tr>
<tr>
<td>TOTAL NUMBERS OF PRODUCTION WELL</td>
<td>: 123</td>
</tr>
<tr>
<td>NUMBERS OF OIL WELL</td>
<td>: 116 (4 #NF, 20 #ESP, 83# SRP, 10 #HPU)</td>
</tr>
<tr>
<td>NUMBERS OF GAS WELL</td>
<td>: 2</td>
</tr>
<tr>
<td>TOTAL NUMBERS OF INJECTION WELL</td>
<td>: 5</td>
</tr>
<tr>
<td>TOTAL NUMBERS OF SUSPENDED WELL</td>
<td>: 82</td>
</tr>
</tbody>
</table>

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Field History & Overview

Production/Lifting Method

- Natural Flow: 4%
- SRP: 83%
- HPU: 10%
- ESP: 19%

NATURAL FLOW, 4
SRP, 83
HPU, 10
ESP, 19

Natural Flow (4)
HPU (10)
SRP (83)
ESP (20)
Field History & Overview

NKL's Production in the early 1976’s was as high as 4,600 BOPD compared to current production of approximately ~7,500 BOPD.
Field History & Overview

OIL PRODUCTION SANGASANGA FIELD 2008 - 2017

- Existing
- Reparation & Reactivation
- Production Optimization
- Drilling
Field History & Overview

NKL Field Limit Diagram

PRODUCTION SYSTEM COMPONENTS

- Reservoir
- Wells
- Lifting
- Production Separator
- Production Tank
- Transfer pump GS
- Truckline GS
- Wash Tank
- SUT tank (A6 & A7)
- Transfer Pump SPU
- PPP Tank
- Transfer Pump Loading
- Loading Line

New Prod. target

- Rejuvenation
- Workover
- Drilling
- Well Optimization
- Repair A8 tank
- Upgrade to B line
Production Optimization Constraint

Mature Field
- High Decline Rate
- High Water cut

Location
- Remote
- Topography (Hills, Rivers)
- Overlapping w/ mining area
- Weather (unpredictable Heavy Rain & wind)

Limited Hoist/Rig numbers
- Old Surface Prod. facilities

✓ Production Target
✓ Reduce Low/off
✓ Push Decline Prod
✓ Reduce Cost
Problem Statement & Analysis

TARGET + CONSTRAINT

IDEA/SOLUTION

ESP REAL TIME SURVEILLANCE

OPTIMUM PRODUCTION

Production Optimization Constraint

Mature Field
- High Decline Rate
- High Water cut

Location
- Remote
- Topography (Hills, Rivers)
- Overlapping w/ mining area
- Weather (Heavy Rain, wind / unpredictable)
- Limited Hold/Rig numbers
- Old Surface Prod. facilities

✔ Production Target
✔ Reduce Low/off
✔ Push Decline Prod
✔ Reduce Cost

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ESP Real Time Surveillance

DH Monitoring Gauge:
• Press. (discharge, intake)
• Temp. (intake, motor)
• Vibration
• Leakage

Data Transmission

✓ REALTIME MONITORING 24/7
✓ QUICK RESPONSE
✓ MINIMIZE DOWNTIMES
✓ OPTIMIZE PRODUCTION FROM OFFICE

IDEA/SOLUTION

Engineer:
• Control
• Monitor
• Analysis (OFM & PIPESIM)
• Decision

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ESP Real Time Surveillance

zedi
ESP Real Time Surveillance

1. Interface of the web page informs ESP parameters at one time
2. Trend line of parameters are shown by clicking daily trend button
3. The trend line shows ESP parameters such as Intake Pressure, Ampere, Frequency, Temperature, and Vibration.

4. Engineers can analyze data to optimize well production.
ESP Real Time Surveillance

5. When a well shuts down, a notification will be sent via email.

6. Or when a parameter is out of its normal condition, a notification also sent via email.
Poduction Analysis Result
Gain – Cost Analysis Result

**Bubble Plot**

- **Surface Activity**
- **Subsurface Activity**
- **Well Activity**

**Gain vs. Duration**

- **Oil Gain (BOEPD)**
- **Duration (Month)**

**Activities:**
- **Production Optimization**
- **Reactivation 13 wells**
- **Dev Drilling 5 wells**
- **Upgrading GL system/Network**
- **Gas Dev. Drilling 7 wells**
- **Infill Drilling 5 wells**
- **Upgrading GL system/Network**

**Success Ratio:**
- **50-90%**
- **>90%**

**Bubble size** = Gain / Cost
Conclusion

ESP Real Time Monitoring implementation in Aseet-5 NKL’s Field was success to:
• Decrease Production Decline
• Minimize Downtime (quick response)
• Optimize Mature Field Production to be smarter and more productive field

Suggestion/Challenge:
• Need improvement on reliability of communication system. Sometimes it breaks up in extreme weather (heavy rain, wind, etc.).
• Need further study to implementing the Real Time Monitoring System for another lifting methods instead of ESP only.
Thank You

terima kasih