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Solutions to Improve Data Accuracy of IPR Determination by Using EMR Swab Modification Innovation

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ABSTRACT

Sangasanga Field is one of the mature fields in the East Kalimantan area; there is a depleted zone in the shallow section (oil zone) and an overpressured zone in the deep section, in which the majority has gas potential. Each layer has a different pressure gradient, so it could be crossflow if layers are produced simultaneously (commingle). Swab work is an essential job to determine the initial indication of whether the well is producing fluid or dry (Production test), in swab work uses standard equipment such as a swab tank, swab lubricator, swab head, swab mandrel, and downhole circuit. In addition to the influx indicator from the reservoir, swabs are used to reduce hydrostatic pressure, unload acid/stimulating fluid, and determine the fluid resulting from drilling or workover work. Swab work can provide an overview of the Inflow Performance Relationship (IPR); the drawback of this method is the calculation based on the approach of fluid level and rate where there are still inaccuracies due to using estimates.

The Bottom Hole Pressure and Temperature survey have a high accuracy l because it uses a Downhole Gauge in the form of an Electric Memory Recorder (EMR). Still, this work requires additional equipment like a Slickline Unit. Bottom Hole Pressure and Temperature Job surveys using a slickline unit cannot be carried out simultaneously. This study is a breakthrough in obtaining more accurate Swab data using EMR in conjunction with a swab job.

Keywords: swabbing job; inflow performance relationship; downhole gauge, electric memory recorder

I. INTRODUCTION

There are many known flowing back methods in completion and workover operations, such as displaced flow, swabbingjob, gas lift unloading, foam, and so on. One method that is widely used because of economic factors is the swab job. Swabbing is the activity of lifting liquid from the wellbore to the surface using a swab cup; this work is usually a series of workovers. The simple working principle provides economic benefits; therefore, swabbing is carried out in many wellsworldwide.

The swab test and the swabbing job are jobs with the same procedure. Still, the swab test is one of the purposes of the swabbing job, with data from the swab test results showing the productivity level of the perforation interval (layer) beingtested. A swabbing job is lifting fluid out of the perforation interval through a swab tool in the tubing of a non-flowing well connected to a swab tank to measure its volume in one run. (Allen. 1996).

Purpose of Swab Job Swabbing Job: (Euvar Naranjo, 2010) to determine the initial indication of whether the well is producing fluid or dry (Production test) in the swab work using standard equipment in the form of a swab tank/ test tank, swab lubricator, swab head, swab mandrel and a series of downhole. Apart from being an indicator of influx from the reservoir, swabs are used to reduce hydrostatic pressure, unload acid/stimulating fluid, and determine the fluid resulting from drilling or workover work.

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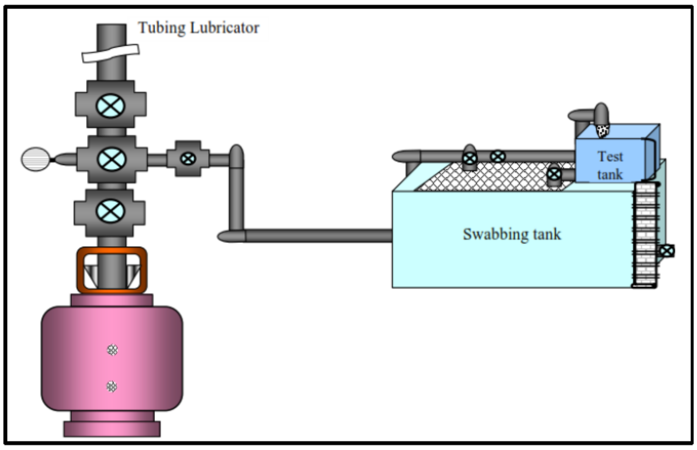

Figure 1. Swabbing Job Surface Equipment

Referring to the problems that occur in the multilayer reservoir of the Sangasanga Field, it is necessary to innovate accurate data collection to determine the potential of the layer to be produced; the determination of IPR (inflow performance relation) determines the design of the artificial lift that will be used which is usually based on work swab, data retrieval with Echometer or EMR (Electronic Memory Recorder) which takes time, there are no tools and methods to combine them. Innovation is needed to determine an accurate IPR at the time of workover so that the optimization of production on time and Lost Production Opportunity (LPO) do not occur.

EMR or Electric Memory Recorder is a tool that measures and records subsurface pressure and temperature data. This tool is essential for surface data and supports subsurface analysis and evaluation.

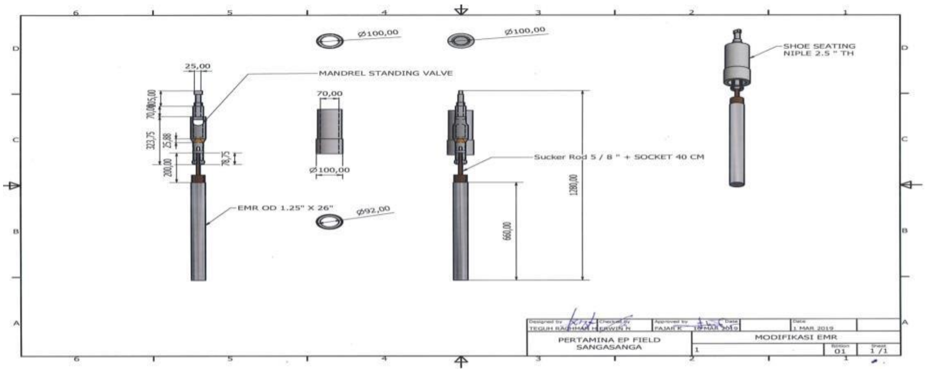

Figure 2. EMR Swab Modification Tool Diagram

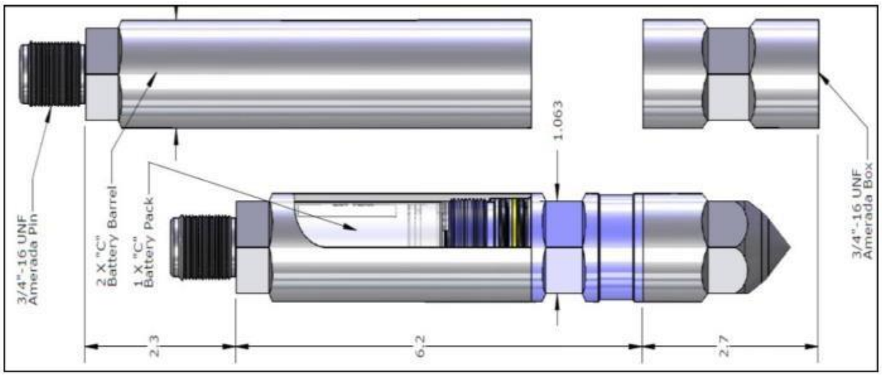

Figure 3. Electric Memory Recorder (EMR)

II. METHODS

One of the examples of wells taken in this case is the NKL-1036 Workover work, in which there is a comparison of conventional swabs and a modified Electric Memory Gauge (EMR) gauge.

The method used in this study is:

1. Layer Potential data collection
2. Implement a Workover program
3. Assessing the Layer Potential of the Perforated Layer
4. IPR evaluation using the equation
5. Comparison of conventional and modified IPR swabs

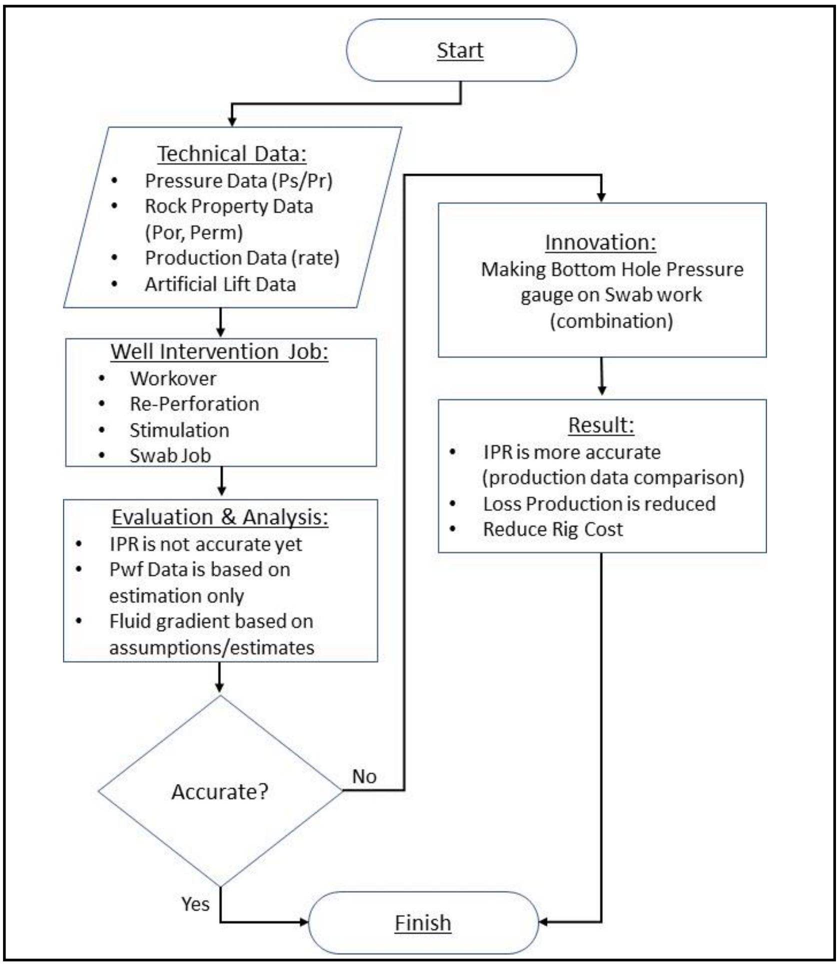

Figure 4. Research Flowchart

III. RESULTS AND DISCUSSION

Workover work has been carried out on this well with perforation layer D-03. To determine the potential of this layer, a swab job was carried out, and the first step was to calculate the IPR approach based on swab data:

1. Determination of SG Mixed Fluid

   $SG = (1 - Wc) \times SG\ Oil + (Wc \times SG\ Water)$

   $SG = (1 - 70\%) \times 0.8845 + (70\% \times 1.01)$

   $SG = 0.3 \times 0.8845 + 0.707$

   $SG = 0.98$

   The Water Cut taken from the initial sample

2. Gradient Fluid (GF)

   $GF = 0.043 \times SG\ Fluid$

   $GF = 0.043 \times 0.98$

GF = 0.042

3. Initial/Static Fluid Level (IFL/SFL)

$$SFL = \text{Swab Depth Initial, ft} - \left(\frac{\text{Swab Rate Initial, bbl}}{0.0087,\ bbl/ft^2}\right).$$

$$SFL = 164.05 - \left(\frac{0{,}5,\ bbl}{0.0087,\ bbl/ft^2}\right).$$

SFL = 164.05 – 57.47

SFL = 106.58 ft

4. Working Fluid Level (WFL)

$$WFL = \text{Swab Depth Stable, ft} - \left(\frac{\text{Swab Rate Stable, bbl}}{0.0087,\ bbl/ft^2}\right).$$

$$WFL = 1{,}148.35 - \left(\frac{0.6,\ bbl}{0.0087,\ bbl/ft^2}\right).$$

WFL = 1,148.35 – 68.96

WFL = 1,079.39 ft

5. Determination of Bottom Well Flow Pressure (Pwf) and Reservoir Pressure (Pr)

Pwf = (Mid perforation – WFL) × Gradient Fluid

Pwf = (1,789.78 ft – 1,079.39) x 0.98

Pwf = 710.39 x 0.98

Pwf = 696.18 psi

6. Pr = (Mid perforation – IFL) × Gradient Fluid

Pr = (1,789.78 – 106.58) x 0.98

Pr = 1,683.2 x 0.98

Pr = 1,649,5 psi

7. Flow Rate per day (Q)

$q_{bbl/d}$ = Swab Depth Stable$_{bbl/mnt}$ x 24_{hours}

$q_{bbl/d}$ = $0{,}6_{bbl/mnt}$ x 24_{hours}

$q_{bbl/d}$ = 576 bbl/d

Determining the Productivity Index (PI) with the equation,

$$J = \frac{q}{Ps\text{-}Pwf},\ bbl/day/psi$$

$$= \frac{576}{1649.5-696.18}$$

= 0.604 bbl/day/psi (PI medium)

Determination of the calculation of the IPR approach using the Standings equation :

$$\frac{q}{q_{max}} = 1 - 0.2\left(\frac{Pwf}{Ps}\right) - 0.8\left(\frac{Pwf}{Ps}\right)^2$$

$$\frac{q}{q_{max}} = 1 - 0.2\left(\frac{696{,}18}{1649.5}\right) - 0.8\left(\frac{696{,}18}{1649.5}\right)^2$$

$$\frac{q}{q_{max}} = 0.19$$

$$q_{max} = \frac{576}{0.77}$$

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q_{max} = 745 bfpd

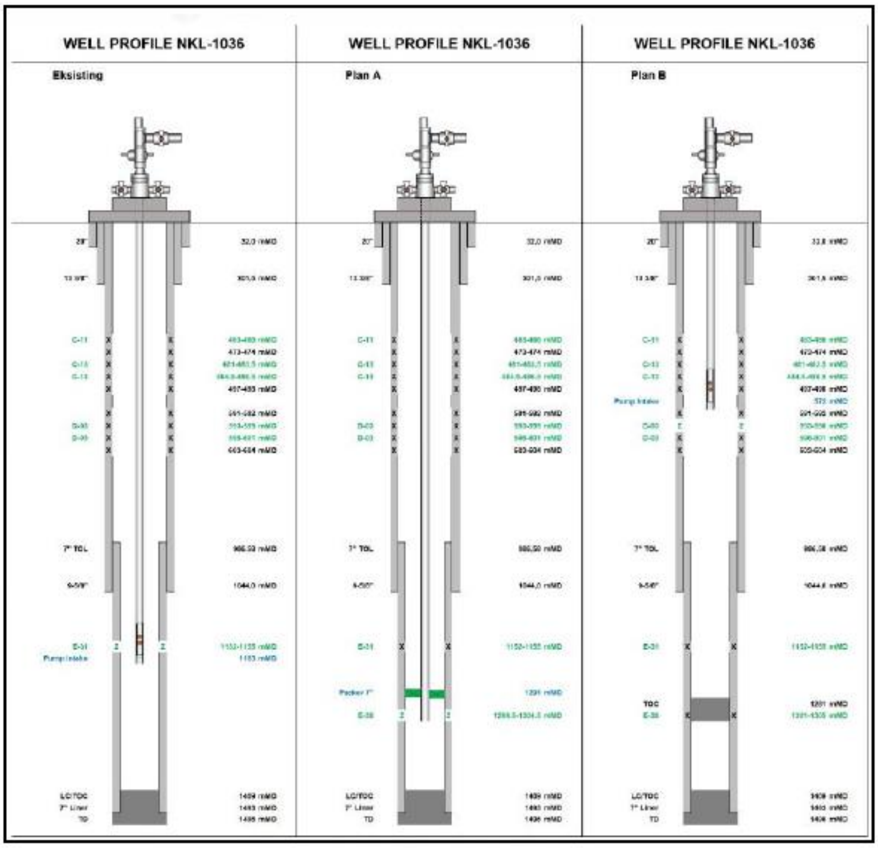

Figure 5. Well Diagram Indicator Well

Date		
Well	IPR SWAB NKL-1036	
Top	593	m
Bottom	596	m
Mid	594.5	m
Gross	576	bfpd
Net	58	bopd
WC	90%	
SG Mix	1.00	
DFL		m
Pwf	696	psi
SFL		m
Ps	1649	psi
Qmax	745	bfpd

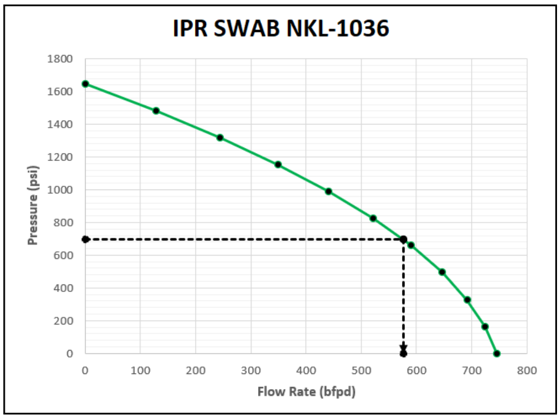

Figure 6. Conventional Standing Swab IPR Curve

Calculation of IPR using Modified EMR Swab (Real Data Recorder),

Ps = 797.34 psi

Pwf = 573 psi

q = 576 bpd

SGres = 0.94

GFfluids = 0.424

Temp = 57.7^{o}C

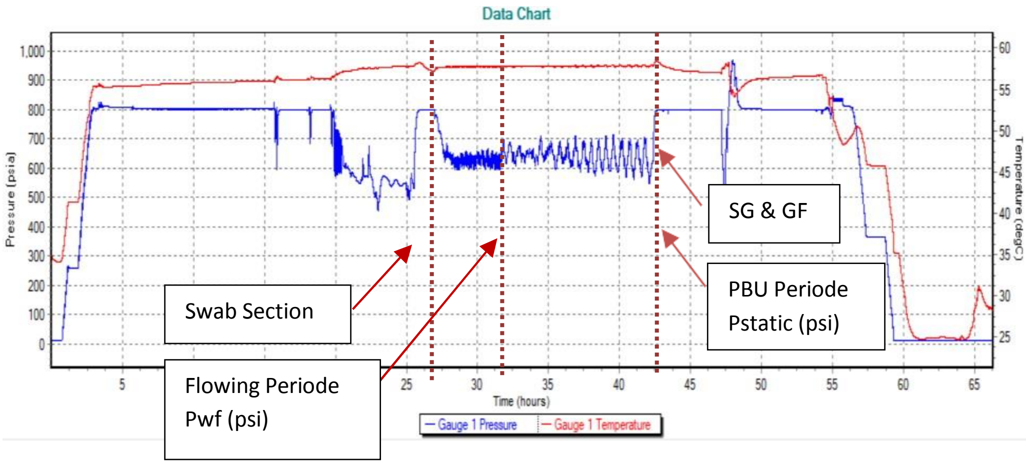

Figure 7. EMR Real Data Recorder during Swab Job

Determining the Productivity Index (PI) with the equation,

$$J = \frac{q}{Ps\text{-}Pwf}\text{, bbl/day/psi}$$

$$= \frac{576}{797.34\text{-}696.18}$$

$$= 5.69 \text{ bbl/day/psi (PI high)}$$

Determination of the calculation of the IPR approach using the Standings equation:

$$\frac{q}{q_{max}} = 1 - 0.2\left(\frac{Pwf}{Ps}\right) - 0.8\left(\frac{Pwf}{Ps}\right)^2$$

$$\frac{q}{q_{max}} = 1 - 0.2\left(\frac{696{,}18}{1649.5}\right) - 0.8\left(\frac{696{,}18}{1649.5}\right)^2$$

$$\frac{q}{q_{max}} = 0.19$$

$$q_{max} = \frac{576}{0.77}$$

$$q_{max} = 745 \text{ bfpd}$$

Date		
Well	IPR SWAB NKL-1036	
Top	593	m
Bottom	596	m
Mid	594.5	m
Gross	576	bfpd
Net	58	bopd
WC	90%	
SG Mix	1.00	
DFL		m
Pwf	573	psi
SFL		m
Ps	797	psi
Qmax	1301	bfpd

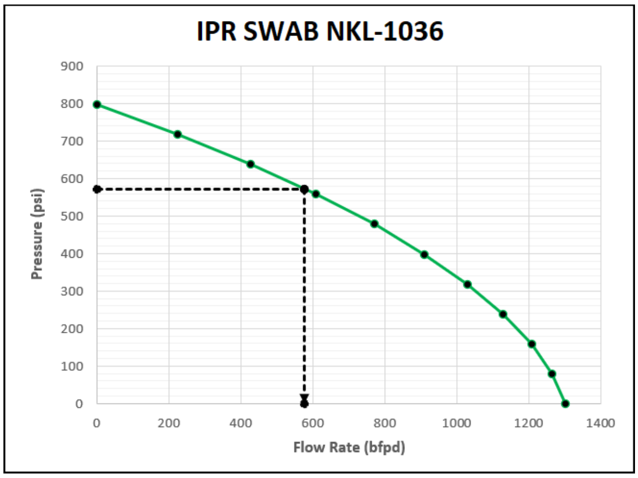

Figure 8. Standing IPR Curve using Real Data Bottom Hole

Evaluation of the comparison results where the IPR closest to the actual condition is to use an Electric Memory Recorder (EMR), confirmed by the following production data.

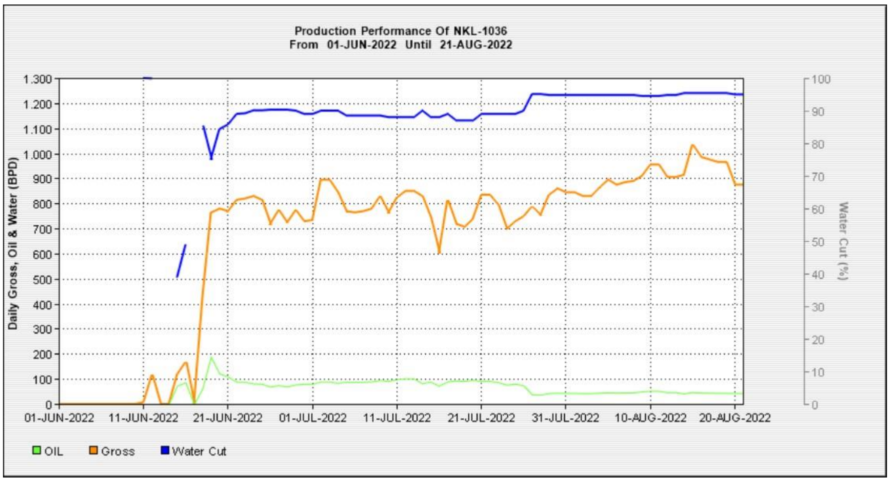

Figure 9. Indicator Well Production Chart

IV. CONCLUSION

1. Inflow Performance Relationship is a way of assessing the potential of the reservoir to be produced.
2. The EMR swab modification tool is an excellent innovation to increase data accuracy, combining Swab workand Bottom Hole Pressure and Temperature survey (in situ) measurements.
3. Calculating Inflow Performance Relationship using conventional swab calculation is still inaccurate because the data is based on the approach (SG, Grad. Fluid, Ps & Pwf).
4. An accurate Inflow Performance Relationship curve will provide the correct output for artificial lift selection.
5. The application of EMR modification tools on drilled, workover, and intervention wells also reduces rig costsfor optimization work, thereby saving rig rental costs and reducing the time the well is off when the rig is working.

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